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Engineering News-Record

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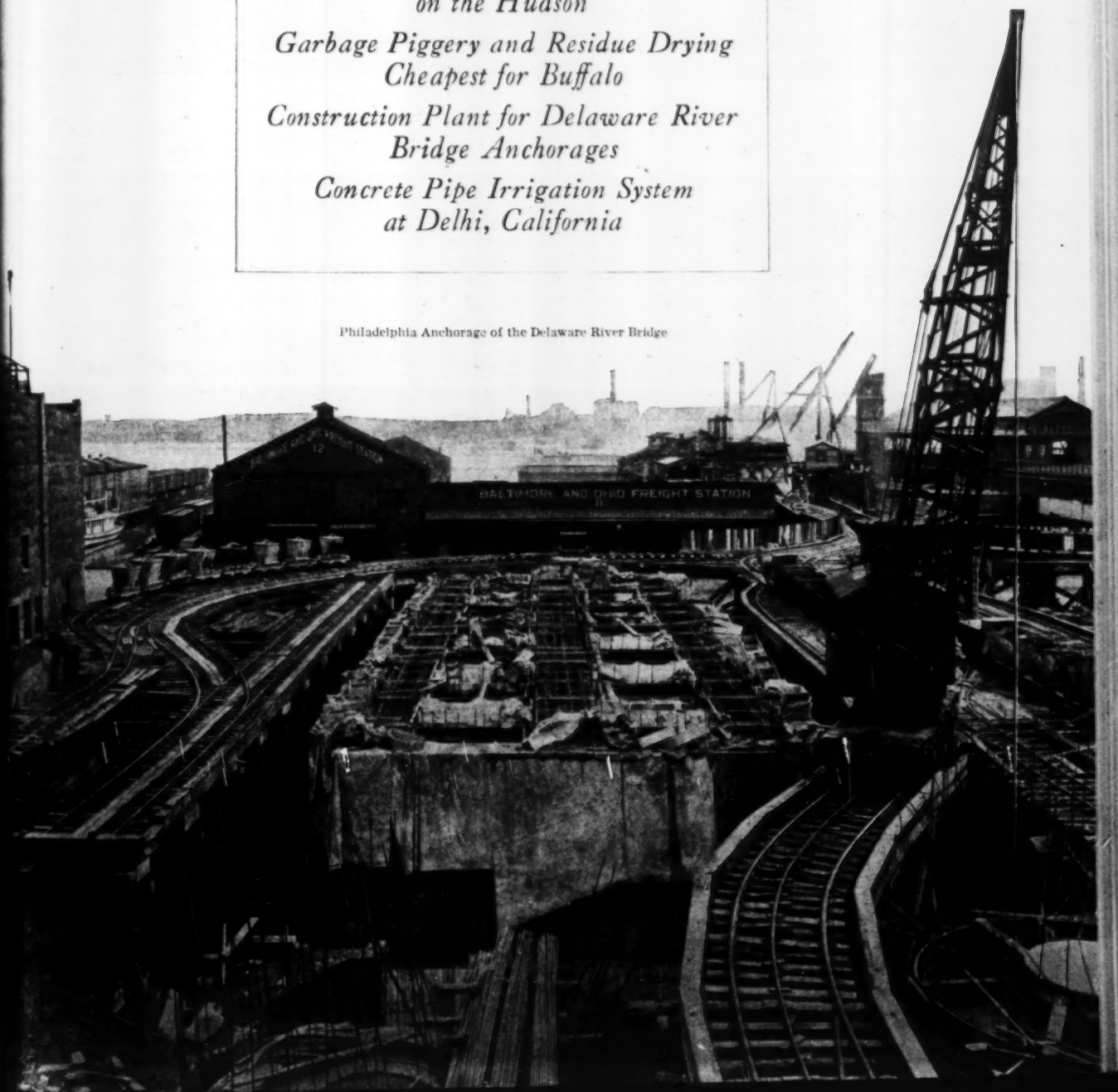
Paper Company Completes Power Plant on the Hudson

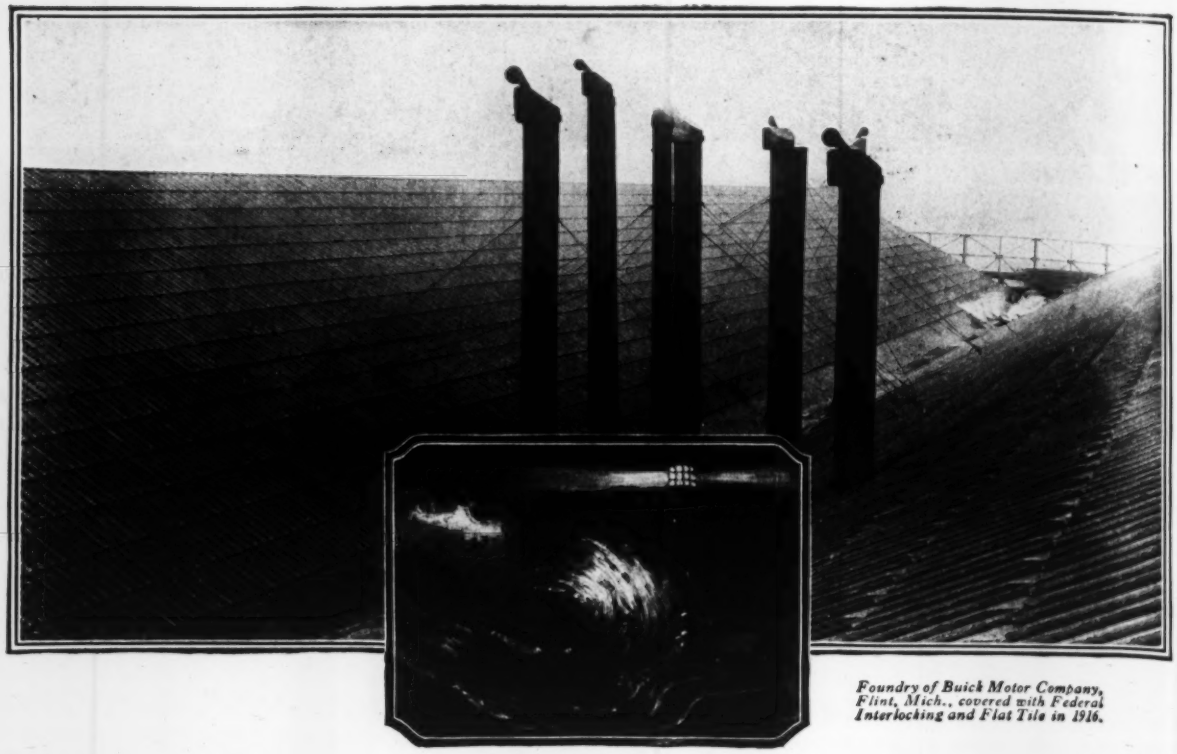
Garbage Piggery and Residue Drying Cheapest for Buffalo

Construction Plant for Delaware River Bridge Anchorages

Concrete Pipe Irrigation System at Delhi, California

Philadelphia Anchorage of the Delaware River Bridge





Foundry of Buick Motor Company, Flint, Mich., covered with Federal Interlocking and Flat Tile in 1916.

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The single substance that can permanently stand up under the battering of the waves is not too good to bear another burden just as great—the roof burden.

Whichever way the blizzard comes—whichever way the sparks fly—whether steam and gases rise whithin or snow and rain fall without—the roof must bear the brunt.

If it is a Federal Roof it ***will;*** hundreds of installations for the foremost organizations in America prove it! To the inherent permanence of concrete, the Federal Cement Tile Co. has added perfect manufacturing methods and advanced engineering that is the outgrowth of long years of specialization. Federal Cement Tile is furnished for all flat and pitched surface. It is made, laid and guaranteed by

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"The Roof for Permanence"

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*
Frank C. Wight, *Managing Editor*

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No Structural News from Japan

JAPAN continues to be cut off from the rest of the world except for some stories which the local reporters consider to have "human interest" and the necessarily colored impressions of those survivors who got away after the first few minutes of the shocks. Efforts are being made by this journal and others to assure an adequate statement of the effect of the earthquake and fire on the modern structures of Tokyo and Yokohama but it will probably be some time before such accounts emerge from the destruction. Meanwhile, from the scattered information available it is becoming increasingly probable that those structures designed to meet the tremors characteristic of the island have, on the whole, justified their design.

Who Gets the Dollars?

FACTS about the coal industry far more accurate and elaborate than ever made public or even known are in the possession of the Federal Coal Commission. They are being issued gradually, partly, it may be assumed, in order to gain continuous publicity but largely because of the difficulties in the actual preparation of the data in understandable form. Some day the whole story will possibly be available in book form so that one with sufficient time and interest may be able to discover why coal costs so much. Just now, however, the consumer is floundering in a sea of statistics sure only of one thing—that coal will be no cheaper. Cannot the commission particularize more than it has? Cannot it state whether royalties are too high, or at least how high they are, and whether wholesaler and retailer are making more today than the average increase of commodities since the price rise began? We have a statement of the wholesalers that their net profit in 1921 was six-tenths of a cent per ton. This sounds so ridiculous that it requires official answer. If in the turnover in which someone makes more money between mine mouth and cellar bin than it costs to mine the coal and pay its capital charges the wholesaler makes less than a cent a ton, who is getting all the rest of the money. The public wants to know.

An Act to Restrict Engineering

THE State of New York will not help a boy to get an engineering education. That, in effect, is the result, apparently just discovered, of the engineers license law that went into effect in that state last month. New York is very generous with scholarships, five worth each $100 a year being annually awarded in each assembly district. In the past many of the boys winning these awards have studied engineering at one of the several engineering schools in the state, and have gone out to become successful engineers. Beginning this year, however, no more scholarship holders will study engineering because of a clause in the enacting law which states that no scholarship "shall include professional instruction in theology, *or in any profession, admission to the practice of which shall require a license from the state.*" Nobody seems to know why the law includes this general professional exclusion, but it should be noted that it operates almost exclusively against the engineer, because law and medicine—the other licensed professions—either require post-graduate courses or can be taken as undergraduate electives in the regular arts course, with some subsequent time for which the scholarship would not be applicable. On the other hand engineering courses are all plainly labeled as such and are almost exclusively undergraduate with small opportunity for election from an arts course. The advocates of licensing never foresaw any such ridiculous restriction as this. Surely some effort should be made to amend the law so as not to discourage the study of engineering.

Marking Road Routes Through Chicago

TOURISTS more frequently lose themselves in large cities than in the country where the main traveled road has fewer competitors to engage the drivers' eye. Picking the proper streets through Chicago has always been a difficult and more or less dangerous procedure, for the through-route connections just inside the city limits have rarely been maintained in passable shape nor has there been any kind of marking within the city limits at all comparable with the average downstate county seat. All this is to be changed. Many of the connections have been repaired this season. As for signs, state highway engineers, county and city officials held a conference recently and decided on a generous sprinkling of uniform aluminum markers along the accepted routes, a zero point at Michigan Avenue and Jackson Boulevard from which mileage for all the radiating roads will be computed and a series of large direction markers. Many another large city could well afford a few dollars for signs of the same type as used on the official highways outside its limits for the satisfying familiarity of the recurring uniform signs is one of the most assuring welcomes the stranger gets from a city through which he drives.

Contractors Need Rail Records

IRREGULAR rail deliveries are an outstanding cause of rehandling materials on construction operations. Railways have the cunning custom of bunching materials cars, coming from several directions to a single consignee, at some convenient transfer point and then delivering them as one trainload. A contractor has for example track and unloading facilities for ten cars a day. For two days he gets no cars from the railway and the next day he gets twenty and his sidings and

unloading equipment are overwhelmed. To escape demurrage charges and the clamor of the railways, backed by the public service commissions, to release open-top cars for coal shipments, cars are, in such contingencies, unloaded where they stand and the materials are rehandled to the regular storage piles or warehouses or to the operation. This is not an imaginary case. There are few highway contractors who cannot cite one or more and generally several instances of bunched deliveries, with all the related consequences, during the present season. Arising out of this situation is one great gain. Contractors are keeping accurate records of car supply, shipping time, deliveries, and unloading periods. By doing this they are not only learning the causes of irregular deliveries and how they may be lessened, but they are helping to do away with the old subterfuge of "unloading delays" behind which the railways have been accustomed to shelter themselves against complaints of slow and irregular shipments of construction materials. A contractor who can support his complaint of poor service or defend himself against a charge of holding up cars by slow unloading with complete shipping records is in a very advantageous position before a public service commission.

Blocking Water Power Use

PRODUCTION of electrical energy by water power has a hard road to travel with the public. There is a deep-seated impression that it costs very little to develop water power and that it is only some inexcusable lethargy on the part of financiers and engineers that has prevented its complete supplantal of steam power. At the same time, in curious contrast to this, every effort to develop water power is met by violent opposition by the same type of mind that wonders at its slow progress—an opposition apparently grounded on the theory that all power developers are foes of the people who in some way are going to make money out of the public domain and resources without recompense to the public and with the greatest possible damage to natural beauty. In New York State today a typical case has arisen in the opposition by a group, who may with no derogatory intent be called "nature lovers," to a constitutional amendment permitting 3 per cent of the Adirondack state lands to be used for power purposes. Unless such an amendment is adopted the cost of transmission of power from the upper rivers to the power using centers will be prohibitive. Furthermore, only 3 per cent of the land is to be so used and that under the regulatory control of the state. And yet the pamphlet issued against the amendment could not be more violent if a group of medieval robber barons were contemplating forcible occupation of the whole of the state. Evidently we are going to be forced to an even higher cost of fuel than that we now enjoy before the serious need of power development is going to be appreciated.

Rehandling Construction Materials

MATERIALS are too frequently rehandled on most construction operations. It takes time and labor to place and then remove to another place sand and stone and lumber and steel. This is a lesson which has been more thoroughly learned in manufacturing than in constructing. To carry most construction materials through the processes absolutely necessary to transform them from raw materials to finished structure requires seven or eight handlings. In factory operations the mechanical conveyor is widely used to facilitate these necessary movements of materials. There is doubtless less opportunity for its use in construction but still too much shifting is done by "strongarm" methods. Too often does one see on large construction operations sacked cement, for example, being shifted from cars to warehouse and from warehouse to the mixer or the service trains on men's backs or by barrows when a few sets of roller conveyors would save men and time. It is, however, the unnecessary handlings which most need to be reduced in construction. A material is unloaded from cars and piled only to be shifted and repiled nearer to where it is used. Lumber and reinforcing bars are unloaded into piles and then sorted out and repiled according to lengths and sizes. Illustrations could be repeated endlessly. Each handling of a construction material which thus does not advance its fabrication into structure is a non-productive expense. Contractors need to study more than they always have done, ways of eliminating these non-productive expenses. No thought is had that the automatic methods of turning out Ford cars can be applied to the operations of road building or bridge erection, but nevertheless it would help to cheapen their materials handling operations if contractors would give some study to factory processes.

Buffalo's Garbage Disposal Predicament

HOW far even our larger cities are from handling garbage disposal in a proper engineering manner is strikingly illustrated by the way Buffalo has dilly-dallied with its local garbage disposal problem for several years past and the predicament in which it now finds itself in consequence. In but one detail did the city authorities act effectively; they do have to their credit the calling in of a competent sanitary engineer for advice on garbage disposal bids but they delayed doing this until after bids had been received on such very open specifications that the engineer called in was compelled to spend much time and go into extensive calculations in order to reduce the bids to a comparative basis.

Although this engineer's report had been before the commission council at Buffalo for months past, and endorsed by the city street commissioner and by the council commissioner in whose department garbage disposal falls, the commission has not acted upon these recommendations. Meanwhile, as has been perfectly apparent for a considerable time past might happen, the city has been ordered by the court to shut down its garbage piggery on allegations that it is a nuisance. This order was to become effective Sept. 15 but the city authorities have secured a hearing for Sept. 26 on an application for a modification of the order and in addition have taken steps to carry the order to a higher court. It is to be expected that the complainants against the piggery will press for shutting it down and that if the court grants the city relief, it will be only because of sympathy for the city in its predicament and because if the plant were closed nuisance might be caused to a far larger number of Buffalo people as a result than would be caused to the relatively few people near the piggery if it were kept in operation.

The Buffalo example is so flagrant a one of failure by a city to see that garbage disposal must be handled

as an engineering problem if grave complications and possible large and unnecessary expense are to be avoided that we present to our readers a condensation of the very exceptional report on the Buffalo bids prepared by H. P. Eddy. The specifications on which bids were asked were so vague and so lacking in the many requirements necessary to make the bids comparable that, as one of our tables shows, revised estimates of cost for a 200-ton plant were far in excess of the proposals; in one case nearly four times as large. Additional calculations were required before Mr. Eddy could reach conclusions as to which method of disposal, among those offered, seemed most desirable. Before reaching this point, Mr. Eddy found it advisable to eliminate entirely all of the bids for garbage disposal by incineration. He also found it necessary to double the city specification allowances for the size of a plant for treating uneaten garbage and hog manure in case a piggery was decided upon.

In passing it may be noted that what will perhaps be to most engineers a matter of great surprise is that after careful consideration Mr. Eddy concluded that in case feeding to hogs were to be adopted, it would be wise to provide a disposal plant for the residue one-half of the daily capacity of the total estimated amount of garbage collected.

The most valuable of all the advice Mr. Eddy has given to the city of Buffalo in this matter, if only the city will heed it—and it is advice that every other city in the country confronted with garbage disposal problems should take to heart—is that the city should decide on some one scheme of disposal, have complete designs made, and then obtain bids for the construction of a plant of that type and size and none other. This is directly opposite to the general practice of American cities. City authorities generally do not put the matter of garbage disposal in the hands of their own engineering force or of competent consulting engineers, have a plan designed and specifications drawn and then ask for bids, all on such a basis of site, size of plant, contract guarantees, test requirements and total annual charges, as will make it possible to compare the bids received understandingly.

Few, if any, cities—and none we hope as large as Buffalo—would think for a minute of asking bids for a pumping station or a filtration plant, to name only two kinds of engineering work, on such vague specifications as those on which the Buffalo garbage disposal bids were based. How indefinite these specifications were may be seen in part from our abstract of Mr. Eddy's report. Had the council commission of Buffalo attempted to award the contract on the basis of comparative bids received—and many another city has done just this sort of thing—it would almost certainly have been sadly disappointed in the results that it would have obtained when it came to count up the actual cost of installing the plant and the total annual charges.

Finally, we regret to have to say that some cities which confine their request for bids to one general type of means of garbage disposal improve upon the Buffalo specifications in degree only; that is, although they may eliminate utterly different methods of doing the same sort of work, they provide neither adequate detailed specifications or contract guarantee and acceptance tests that will indicate with any certainty what the plant will really accomplish in daily operation.

It is high time that our cities make some change in their methods of treating garbage disposal. It is to be hoped that after its present experience, Buffalo before again advertising for bids will follow Mr. Eddy's advice as to definite plans and specifications for one type of plant. Judging from reports of commission council proceedings since Mr. Eddy's report was submitted, the commission council has not yet seen this matter in its full and true light.

General Service Equipment Economies

PROCEDURES which have almost the characteristics of principles of plant engineering were followed in planning the construction plants for the Delaware River Bridge anchorages described in this issue. The conditions of the specific problem at Philadelphia and the lines of reasoning which naturally followed need not be repeated. Outstanding from the details are: (1) Selection of plant units to permit interchange of duties; (2) provision for intra-operation mobility of these units, and (3) consideration of their future utility. All these are ideas of an economic significance which reaches beyond any specific piece of construction work.

Specialization of construction equipment has proceeded so far and produced such great economies that when large volumes are involved it requires a wrench to separate our minds from the thought that necessarily large-capacity special machines are the universally logically selection. In the Delaware River Bridge anchorages there was a large volume of excavation to be removed, and a larger volume of concrete to be put in place. Considering volume alone either the excavation or the concrete placing warranted large-capacity special equipment. It was not adopted for sound economic reasons. Alternation of excavating and concreting operations made the output capacity and speed of special machines of no benefit. This is a condition which frequently prevails in construction operations; the aggregate volume of each kind of work is large but the volumes which can be accomplished as continuous operations are small.

Again, as at Philadelphia, the alternations of operations are frequent in many construction processes. On the bridge anchorages excavation, concrete placing and a period of rest for the concrete to harden was the succession continuously repeated. The only plan by which equipment can be kept busy under such conditions, which incidentally are common in many classes of construction, is to keep it moving from one structural unit to another. This requires intra-operation mobility which exceeds mere ability to move the equipment units easily and approaches a continuous circulation of equipment, such as on the anchorage work was provided by interconnecting tracks, locomotives and traveling cranes.

General service equipment met the conditions better than could any special equipment however superior that might be under conditions which permitted its full efficiency. Furthermore it possessed a greater salvage value. It was usable plant for future operations of great variety. With this we have a summation of values which the contractor should appraise carefully in outfitting a construction operation—ability to shift from one duty to another and from one point of operation to another and, finally, salability as second-hand equipment.

Anchorage Construction Plant, Delaware River Bridge

Sequence of Changing Operations Handled by Mobile Units on Overhead Track System Transport by Scows Solved Problem of Limited Land Area for Storage

BUILDING the anchorages for the Delaware River Bridge called for careful planning of the construction plant. The structures and their location were closely alike, the quantities were large, the kinds of work varied and the main processes had to be performed alternately. Combined with limited working room and congested means of transportation except by water, these conditions made plant layout a serious consideration. The contractors met the situation by installing (1) a loading and unloading station and a concrete mixing plant on the river front, (2) a service railway

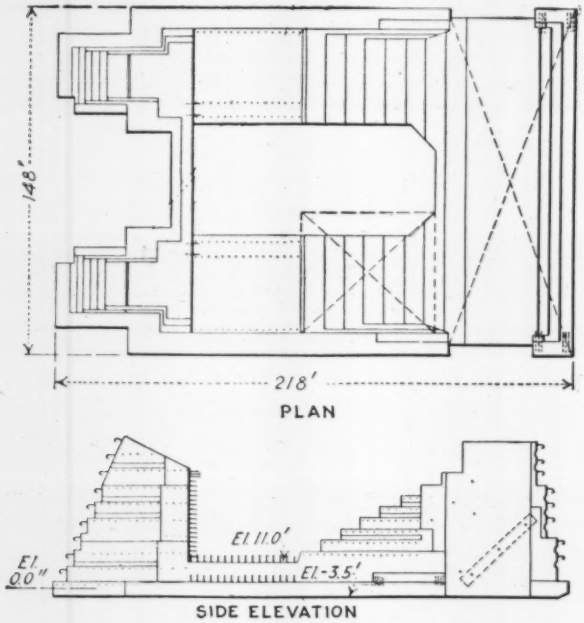


FIG. 1—PLAN AND ELEVATION OF ANCHORAGE SUPERSTRUCTURE

on trestle from the river front installation to the anchorage site, and (3) an overhead crane-track and service-track system covering the anchorage site. This arrangement was approximately duplicated for the two anchorages.

Anchorage Structure—In general design the anchorages are alike. Each consists of a superstructure, Fig. 1, approximately identical and of a substructure of reinforced-concrete caissons filled with concrete. There are ten caissons for each—two rectangular and eight circular. The quantities in the two superstructures are nearly the same:

Materials	Philadelphia	Camden
Concrete, cu.yd.	29,630	29,930
Reinforcing, lb.	239,000	233,000
Anchorage steel, lb.	2,322,000	2,322,000

In the caisson substructures the differences are greater because the rectangular caissons on the Camden side are larger and their depths to rock are different. The substructure quantities are approximately as follows:

Materials	Camden	Philadelphia
Concrete, cu.yd.	47,000	28,500
Open pit excavation, cu.yd.	1,150	8,000

Combining the two sets of figures the main quantities are as follows:

Item	Camden	Philadelphia
Concrete, cu.yd.	76,930	58,130
Excavation, cu.yd.	48,150	36,500
Anchorage steel, lb.	2,322,000	2,322,000

One fact further requires notice; the caissons are open—reinforced concrete shells and partitions sunk by dredging from the inside and built up as sinking proceeds. Their structural character is shown clearly enough by any of the views.

General Conditions—With the structures and quantities as outlined, the general conditions were as follows:

1. There were to be built on opposite sides of a wide river two structures identical in character and involving approximately the same quantities. The contractor for these structures was also the contractor for the adjacent piers and had plant installed and work well advanced on the piers when the anchorage contracts were secured.

2. There was available on each side of the river a working area not greatly larger than the horizontal projection of the bridge structure between pier and anchorage. The anchorage structures virtually covered the sites purchased for anchorages. Both piers were in the river. On the Philadelphia side the anchorage was inland and between it and the pier the bridge area was occupied largely by a busy waterfront street and approaches to pier sheds and ferries. On the Camden side the anchorage was on the river's edge and between it and the pier was open water.

3. Railway track service to the anchorage sites was not easy to secure on either side but more particularly on the Philadelphia side. There was on either anchorage site no adequate track and storage yard room for materials and supplies or for disposing of excavated material. In contrast the river offered a natural means of bringing in material and taking away spoil, with the advantages of complete flexibility of movement, large cargo shipments and low rates.

From the general conditions it appeared, conclusively, that (1) two similar construction plants were required; (2) the river should be the way for bringing in material and removing excavation and (3) the plant for pier and anchorage should be combined as far as practicable. With these general conclusions reached, the operations which the plant would be required to perform came up for consideration.

Controlling Operations—Obviously the controlling processes were (1) removing excavated material from the anchorage emplacement and (2) putting concrete into the anchorage structure. Incidental to excavation and producing and placing concrete were the operations of handling forms and reinforcing steel and of

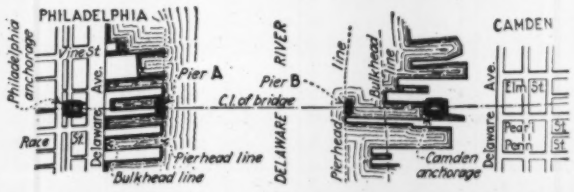


FIG. 2—LOCATION PLAN OF PIERS AND ANCHORAGES

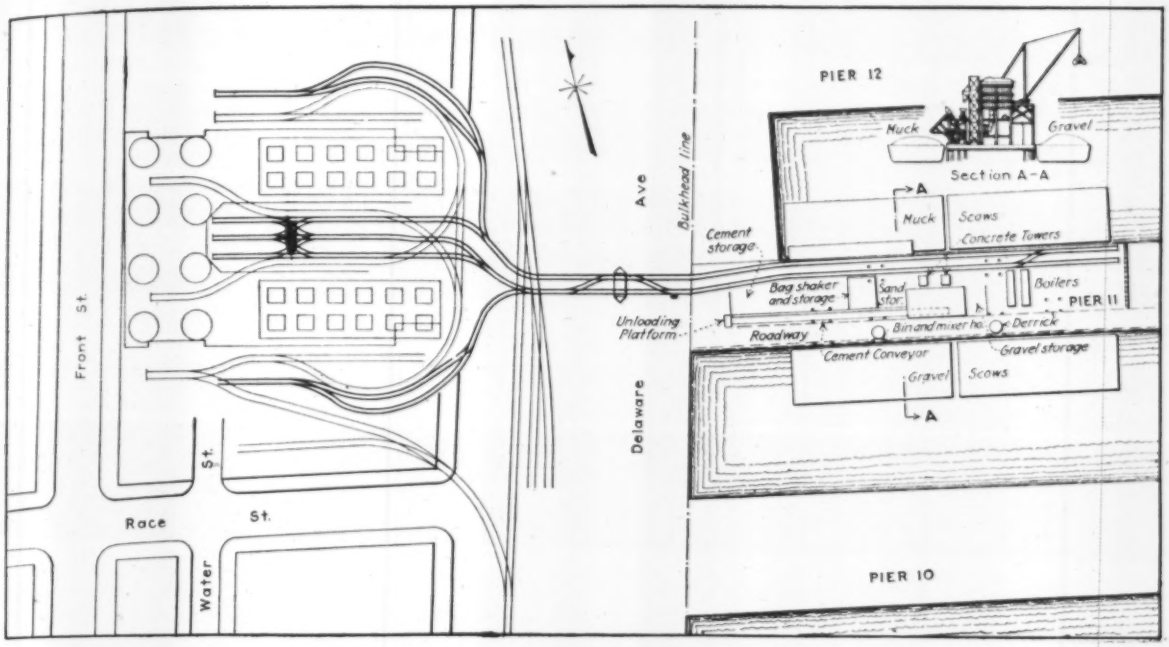


FIG. 3—DETAIL PLANT PLAN FOR PHILADELPHIA ANCHORAGE

installing the anchorage steel, and finally, miscellaneous materials handling. Analysis of the several operations brought out a number of facts affecting plant selection and arrangement.

The excavation did not call for the quick handling of large volumes. About seven-eighths of the yardage had to be taken from caisson wells and in the case of the large caissons, with numerous wells, removal had to be divided evenly between them all. This made the process necessarily slow. There followed then the necessity of accumulation in piles or of holding shipping units some time in receiving the load; and as has been pointed out there was no room on the anchorage sites for either procedure. In the same way, concreting any particular caisson unit was a slow process—each lift of a few feet required only a moderate yardage, had to harden and get strength and the caisson had to be lowered before another lift could be concreted. To get output, then, in either excavation or placing concrete, it was necessary to put all the caissons under way and to shift work from one to another so as to keep both operations practically continuous.

Plant Planning—Plants had been installed for building the bridge piers. Each consisted of bins, mixer, hoist tower and chutes and equipment for unloading scows and for loading excavated material into scows.

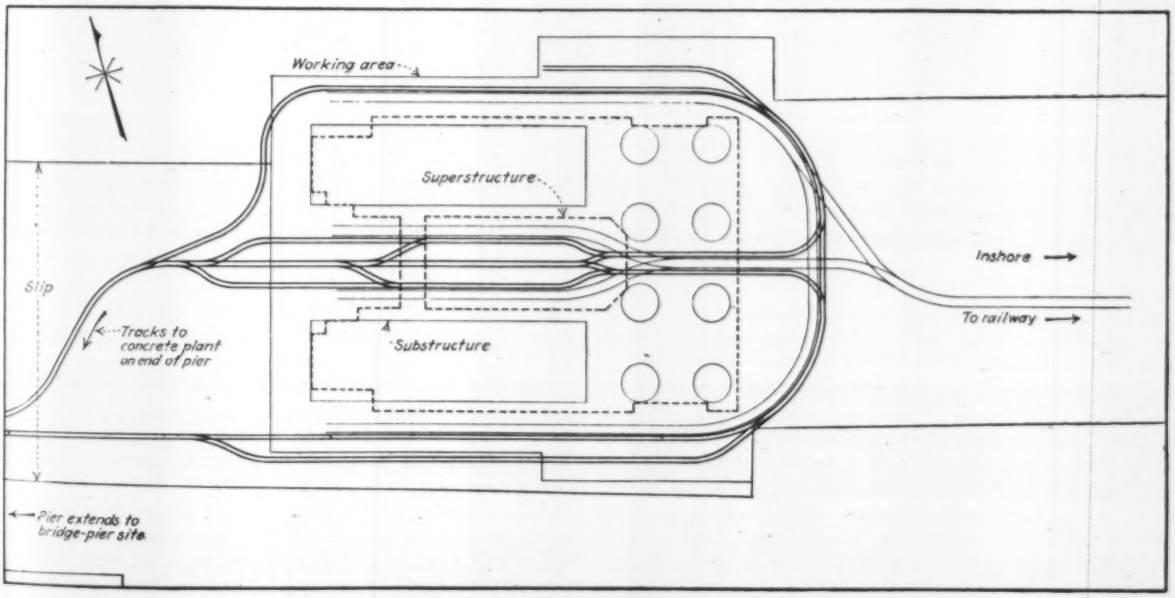


FIG. 4—DIAGRAM TRACK PLAN FOR CAMDEN ANCHORAGE

Both were located on the ends of shipping piers reaching outshore to points close to the bridge piers (Fig. 2). Substantially the same equipment units and plant functions were necessary in building the anchorages. It was, therefore, planned to trestle from the pier plants to the anchorages and over the anchorage sites as shown by succeeding drawings and views; to lay elevated service and crane tracks on the trestle, and to install locomotive cranes and narrow-gage locomotives and cars.

In general the plan was the same for both anchorages. or other materials either in single carloads or in train loads of as many cars as may be needed.

Extension of the services of the pier construction plants to the work of anchorage construction supplemented the flexibility of the trestle outfits. By water materials could be received and spoil removed with almost complete independence in respect to time or volume. There was no problem of storing material on the construction site. By the trestle also the streets were kept clear of contractor's traffic.

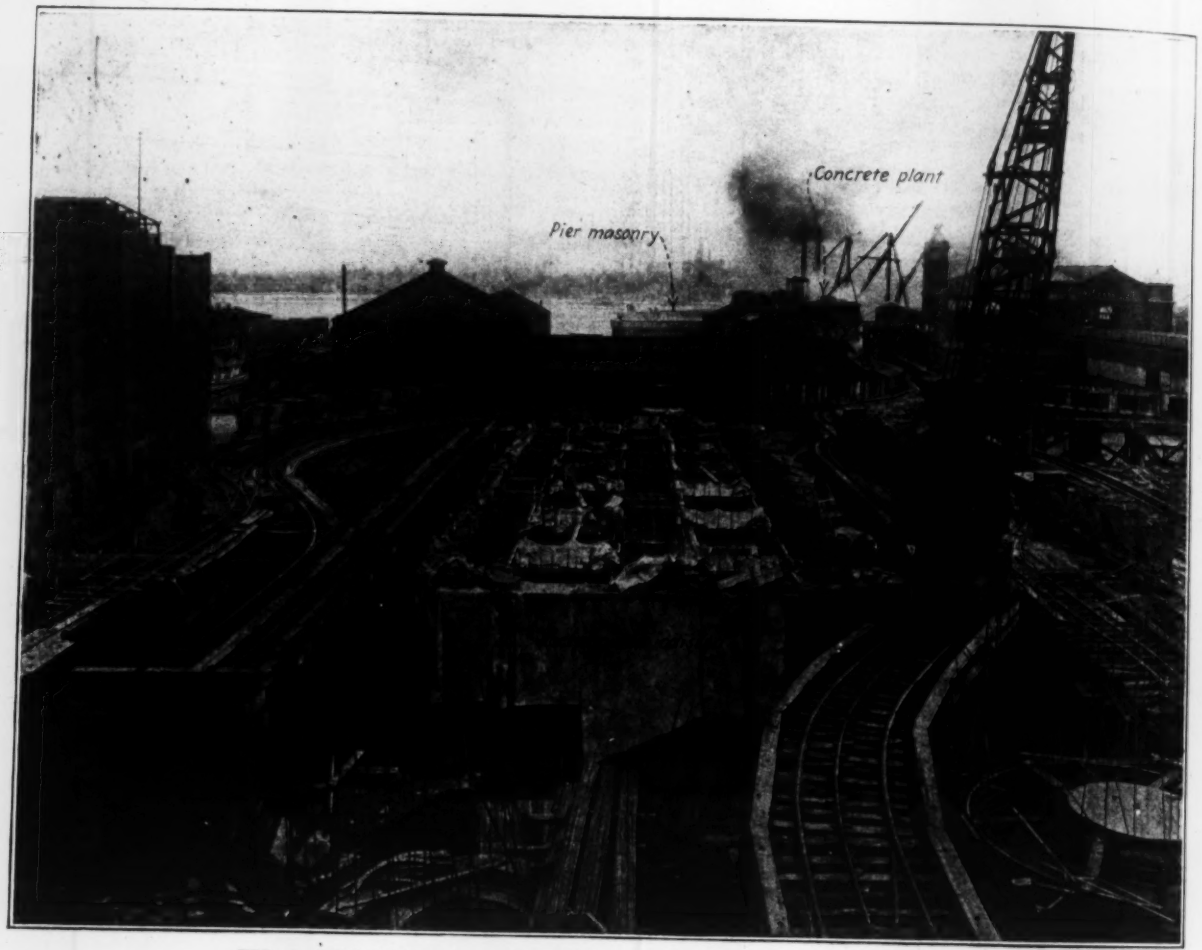


FIG. 5—PHILADELPHIA ANCHORAGE, NORTH CAISSONS, LOOKING EAST

Fig. 3 shows the complete layout for the Philadelphia operation. Here there was no possible access to the anchorage from the rear and access to the elevated track system is by a ramp from railway tracks on Delaware Ave. On the New Jersey side the only approach to the anchorage site was from the rear and here the incline to the elevated track system was built as indicated in diagram by Fig. 4. Figures 5 and 6 are views of parts of the two anchorage plants during caisson sinking—track system, equipment and structure are clearly indicated. The track system is so arranged that every part of the anchorage structure is put within reach of a locomotive crane and a service train. Indeed almost complete flexibility has been secured, as shown by:

1. The cranes can excavate with clamshell, place concrete, shift forms, handle reinforcement and anchorage steel equally well and they can be grouped and scattered as the operation requires.

2. The service trains can handle concrete or spoil

Construction Methods—Methods of construction are interesting chiefly in connection with sinking and seating the caissons and they are not completed and are a subject for separate consideration. As affecting plant, construction is a sequence of changing operations. For example excavation proceeds from inside a caisson until the shell has gone down a certain distance and then excavation is discontinued so that the caisson can be built higher. This is the entirely different process of concrete construction, including form erection and placing reinforcement and concrete, followed by an interval of idleness while the construction is getting strength. Then excavation is resumed. Repeated for ten caissons distributed over an area 148 x 218 ft., these operations call for constant shifting of duties. The case will be the same in superstructure construction where placing concrete will alternate with the processes of very precise erection of anchorage steel. The requirements, it was considered, were best met by a plant of many units

which could be separated or combined as desired, providing a substantial freedom of movement.

In operation the arrangement has been successful. It has been possible to keep the caissons progressing quite uniformly and so to schedule procedure that there is little idle plant time. Another economic feature is that, with the exception of some of the steel form units, there is hardly an item of plant which is not of general usefulness in construction operations of numerous kinds.

Directing Organization—The construction of the Delaware River Bridge is in charge of a board of engineers of which Ralph Modjeski is chief engineer and George S. Webster and Laurence A. Ball are members. Clement E. Chase is principal assistant engineer and M. B. Case is senior resident engineer. The contractors are the Keystone State Construction Co., and Holbrook, Cabot & Rollins Corp.

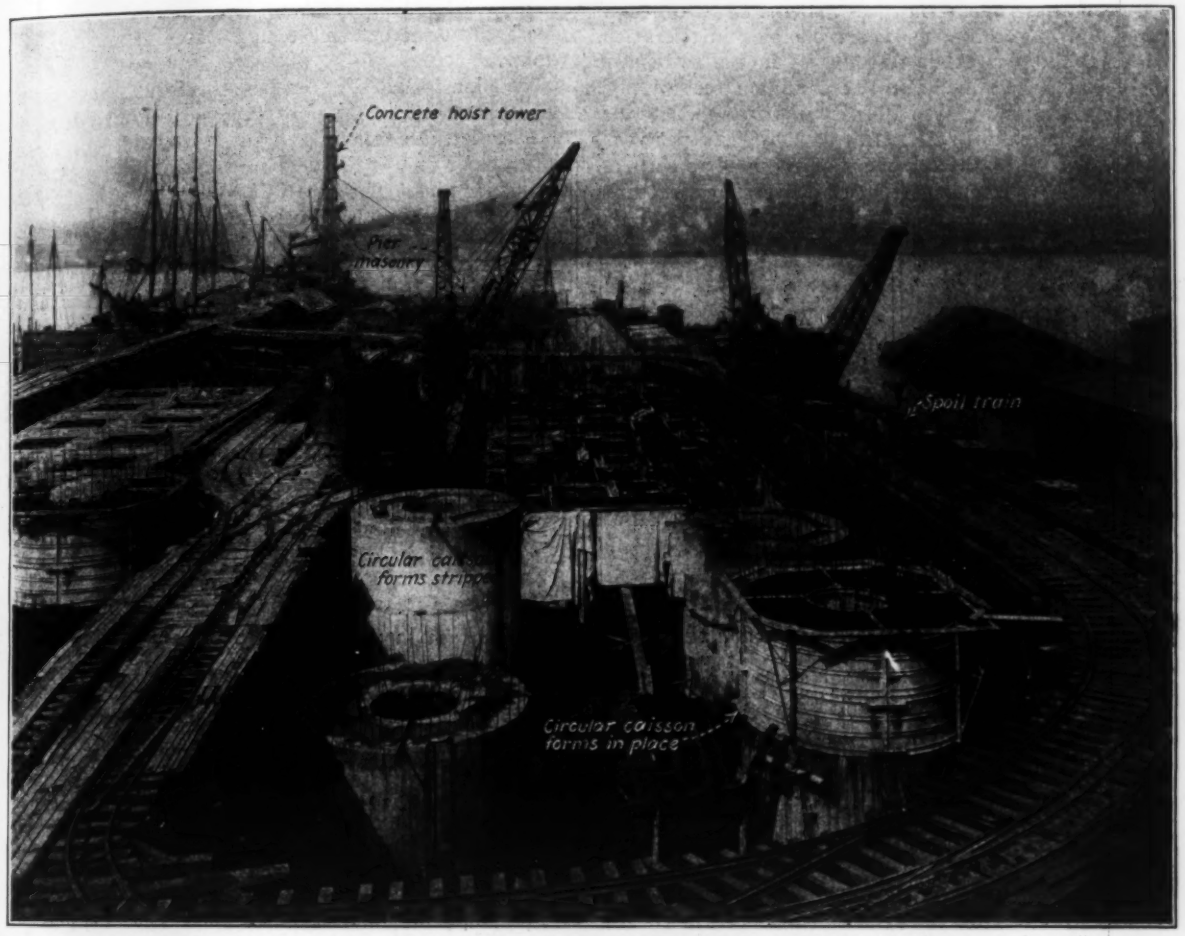


FIG. 6—CAMDEN ANCHORAGE LOOKING WEST

New Concrete Ties Used in India

The Northwestern Ry. of India has made exhaustive tests of a new type concrete railway tie patented by a Delhi consulting engineer, says a recent report to the Department of Commerce from the Calcutta vice-consul. Use of the tie on 50 miles of track near Delhi has been so satisfactory that 70 more miles are to be similarly equipped. The tie consists of two concrete blocks joined together by a tiebar, the rails being fastened by means of a screw or dog spike driven into wooden plugs, treated and compressed, inset in the concrete block.

Sanitary Engineering on the Cotton Belt Ry.

UNDER THE heading of "Activities of Sanitary Engineer" the annual report of St. Louis Southwestern Ry. contains the following statement on malaria control work:

"Malaria control work conducted by this department was continued throughout the year with success. The distribution of quinine in prophylactic doses was extended to track employees on 831 miles of the operated mileage.

The effectiveness of this method of malaria prevention is evidenced by the fact that only 24 section men were admitted to the hospital suffering from malaria, compared with an annual average admittance from this class of employees of 259 prior to the inauguration of malaria control. During the year a total of 98 malaria cases were treated at the company hospital.

This is a decrease of 504 compared with the average number treated during the four years prior to malaria control. Through the influence of this department the cities of Pine Bluff, Ark., and Hillsboro and Wells, Texas, inaugurated a malaria control campaign, and the interest of other cities and towns has been maintained through malaria essay contests conducted in the schools and through contact with educators and city and public health officials."

Concrete Pipe Irrigation System Delhi Settlement

Million Feet of Pipe Being Laid by California State Land Settlement—Buried Sand Traps and Other Features Described

By John R. Jahn
Irrigation and Land Settlement Engineer, Berkeley, Calif.

THE CONCRETE pipe irrigation system at Delhi, near Merced, Calif., has many interesting features and is effecting marked economies in operation. Although there are but 8,500 acres in the settlement there will eventually be in use a million feet of pipe ranging in size from the 30-in. mains to 8-in. laterals. This is being laid in units of some 250,000 ft. per year, keeping ahead of the allotment of the land to settlers. The system is complete from the diversion structures for the gravity water supply, at the canals, and the

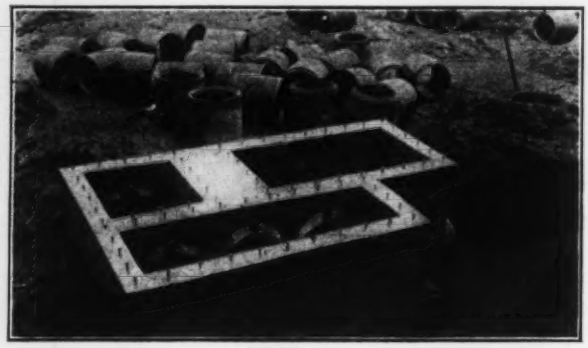


FIG. 1—COVERED THREE-COMPARTMENT SEALED GATE CHAMBER
Boiler plate covers compress square hemp packing by means of stud nuts. Two of the screw gates do not show in this view

pumping plants, through the main distributing pipe lines and division boxes to the alfalfa or orchard valves on the field laterals. Water is distributed among the five hundred farm units by two or three water tenders.

The ground surface at the colony consists of gently rolling ridges and swales—about 40 per cent being above the elevations which could be supplied economically by gravity from the existing canals of the Turlock Irrigation District. The soil is a fine sand and canal seepage losses are high. These features, together with the increased economy of application of water and the saving of land for farming, led to the adoption of concrete pipe.

In designing the system a topographic survey was made of the land and contour maps were drawn having a scale 1 in. = 100 ft. These maps were in half-section (320-acre) units and showed about six elevations per acre with 1-ft. contours. These sheets were reduced by pantograph and combined to form a key map having a scale of 1 in. = 800 ft., with 5-ft. contours. The subdivision design was made on a basis of topography by aid of the detail sheets and was transferred to the key map. The distributing mains were laid out on this key map to serve every farm unit from at least one connection.

These main lines generally serve some areas which are above the gravity supply. Pumps are used: (1) to boost the gravity supply to the higher levels; or (2) to lift it from wells or from the Merced River. The main lines are so looped, and controlled by gates, that one area may obtain water from another and different sections be supplied either by gravity or pressure.

The concrete pipe is made in an enclosed plant having air tamping machinery for sizes of 18 to 30 in. and a Brubaker pipe machine for sizes of 6 to 16 in. Among the novel features of this plant are the Lowden overhead carrier for moving the pipe on trays from the Brubaker machine to the curing yard, and the Skinner overhead spray system for keeping the pipe moist while curing. The inclosed plant protects the pipe against the extreme temperatures of summer and winter.

The pipe is laid in trenches cut to sufficient depth to have at least 18 in. of earth cover. For 18-in. pipe and smaller, the excavation is done by hand on a piecework or per foot basis. A power excavator is used for the larger pipe. The pipe is laid by contract, the contractor furnishing the laying materials with the exception of sand. The settlement district hauls the pipe and distributes it along the prepared trenches. The pipe is laid, joints banded with mortar and backfilled to a depth of 3 in. over the pipe by the laying contractor. The remainder of the backfilling is done by hand or with stock on a piecework or footage basis.

The following unit costs per completed foot of line are used as a basis for estimates:

Size of Pipe, Inches	Price per Foot, Cents
8	33.4
10	41.8
12	55.3
14	70.8
16	83.7
18	109.0
20	155.6
24	192.5
30	303.6

The maximum pressure head on any main line is 45 ft. but there are many instances of pressure heads which range from 20 to 40 ft. In 1920 it was the practice to place electrically welded rings of No. 6 steel wire ($\frac{1}{8}$-in.) within the pipe shell for reinforcement but the difficulty of centering these properly led to the adoption of other methods. The pipe to be used under pressure heads greater than 15 ft. are now wrapped outside with rings of No. 2 ($\frac{1}{4}$-in.) steel wire at the ends and center of each joint. By twisting the loose ends of the wire together the concrete of the shell is put in slight compression. These rings are covered with joint mortar for protection against rust. Another form of reinforcement that has been used consists of strips of $\frac{3}{4}$-in. square mesh screen, 8 in. in width, encircling the pipe and encased in banding mortar. These bands are spaced 50 to 100 ft. apart on a pressure line to guard against extensive longitudinal ruptures. No pipe smaller than 14 in. is reinforced nor is any used on low pressure lines of larger sizes.

Among the special appliances developed in the construction of this pipe irrigation system attention is called to four types of structures: (1) Sealed gate chambers; (2) capped stands; (3) buried sand traps; (4) overflow syphon spills.

Sealed gates and capped stands are constructed in the pipe-making plant and moved by trucks to the field. They are complete with screw gates installed and have inlet and outlet pipe nipples for connection to pipe lines. The sealed gates have from one to four screw gates on their four inside faces while the capped stands seldom have more than one, which is placed over the

inlet port. The object of these enclosed gate chambers is to provide cutoffs without high, open gate chambers, since they are often used where the hydraulic grade line stands 30 ft. or more above the ground surface. The capped stand differs from the sealed gate in that it is built up of sections of 18-, 20- or 24-in. concrete pipe, while the sealed gate requires collapsible inside and outside forms. The sealed gate has a cover of ¼-in. boiler plate, held down by nuts on ½-in. bronze bolts. A ring of ⅜-in. square hemp packing between

FIG. 2—CAPPED STANDPIPE BEFORE BACKFILLING

the plate and the concrete body makes the chamber watertight. The screw gate stems pass through stuffing boxes which are acetylene welded to the boiler plate covers. Installed, the tops of these sealed gates are about even with the ground surface and the gate stems, which are of ¾-in. wrought-iron pipe with special T handles and stand 2 to 3 ft. above the surface. A sealed gate with one 12-in. and two 10-in. screw gates, costs complete and installed about $60. Access to the gates may be had at any time by closing the inlet gate and removing the nuts from the bolts which hold down the cover.

The capped stand was developed by Ernest Fortier and has proved very satisfactory. It has a good appearance in the field. A special ring form joins the cap and the stand. Hemp packing is used here and compression is obtained by screwing down nuts on the four rods which reach from a spider in the base up the outside of the pipe to a similar spider in the top. The cost of one of these, with a 12-in. gate, is about $35, installed. There is usually enough space between the valve stem and the stuffing box to allow trapped air to escape although some have been built with automatic air-vent valves.

Buried sand traps are used to remove sand from water which is pumped from the wells. Their advantage over those of the usual vertical type is that the water does not have to be lifted above the level of the ground surface to function. Ten feet or more of 24- or 30-in. pipe is laid horizontally 18 in. below the ground surface. Pump connection is made above the center line at one end and the sand flushing port is at the bottom of the other end. The discharge to the main line is taken from a riser in the sand trap 7 ft. or more from the pump connection and has a cutoff screw gate in the sealed gate chamber to allow water to pass on through the main line when desired. A standpipe of 10- or 12-in. galvanized-iron pipe relieves water surges. The economy of this type over the usual vertical chamber in which water is lifted over a dividing wall comes from a saving in power. It is estimated that the electric power used in lifting 500 g.p.m. 4 ft. higher than necessary during a seven months' irrigation season costs about $30, which can be saved by the buried chamber type. The cost of this type of sand chamber, complete with flushing screw gate and vertical galvanized-iron surge pipe, is about $200, installed.

A few words may be said concerning the wells of the settlement. The objects of these are to: (1) augment the gravity irrigation supply; (2) serve land above the economic gravity hydraulic grade line; (3) decrease the sizes of main lines; and (4) promote drainage by lowering the ground water table. They are located at strategic points and provide from 500 to 1,000 g.p.m. Suitable water-bearing gravel is found in different strata, the usual depth being 80 to 120 ft. The water table stands at 12 to 25 ft. and the economic draw down of from 25 to 40 ft. depends on the elevation of the ground surface.

The different types of pumps that have been used in the several installations are: (a) horizontal centrifugals; (b) vertical turbines; (c) vertical centrifugals. The latter type is being used for lifting water from the Turlock Irrigation District's canals and is so hung that the pump itself is submerged. All of the pumps are giving satisfaction, the different types being fitted to the different working conditions. Electric power is obtained from the San Joaquin Light & Power Corporation.

The overflow siphon spill and surge pipe, Fig. 3, was developed to protect the pipe lines against harmful increases in pressure, which might be caused by an irrigator closing his alfalfa valves without notifying the water tender. The novel feature is the inexpensive conical cap which connects the riser with the discharge pipe. The discharge pipe conducts overflowing water to safe waste-way. Normally the water stands in the riser at the hydraulic grade line. When the water level rises due to the closing of a valve, the water spills and falls as a simple overflow until a siphoning column is built up, when the discharge increases. The siphon is broken by the 4-in. opening at the point of the cap when the hydraulic grade line drops to that level. Were it not for this opening the siphon would not be broken until the hydraulic grade line fell to a point near the ground surface, thereby wasting water unnecessarily. The action of these siphon overflows is intermittent up to the capacity of the riser. One of these, with a 10-in. discharge pipe, has handled 1,000 g.p.m. without overflowing the open cap.

This pipe irrigation system has in many ways proven its superiority over open ditches. Its first cost is its chief drawback. This amounts to about $36 per acre for the main distributing system, to which the farmers' private lines add about $43. This is advanced

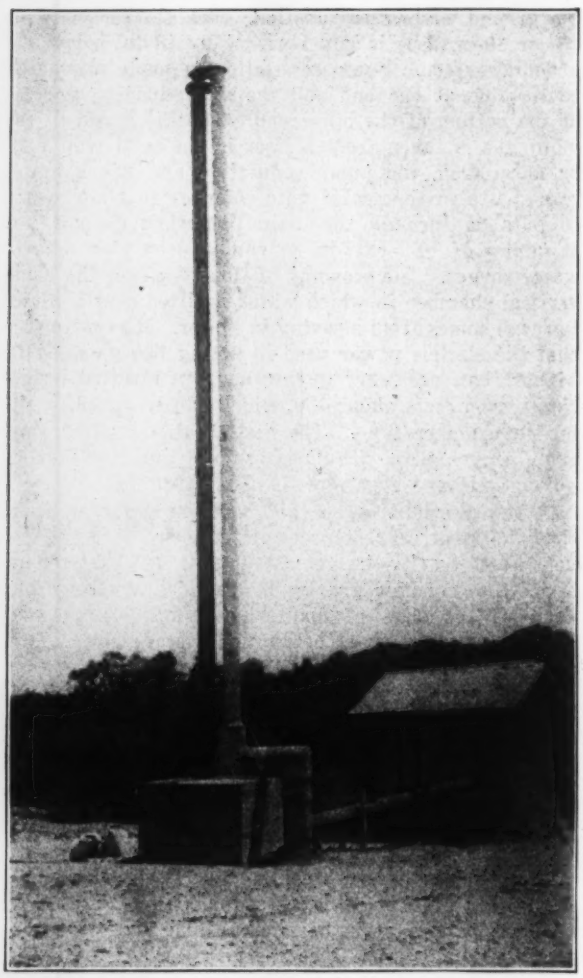


FIG. 3—SURGE AND OVERFLOW SIPHON SPILL, MERCED RIVER PUMPING STATION

the settler by the state but is repaid by him in amortized payments at the rate of about $5 per acre per year, interest being 5 per cent on the outstanding principal.

The Delhi Colony is one of the California State Land Settlements carried out under Dr. Elwood Mead as chief of the division and Walter Packard as the Delhi superintendent. The system was designed and constructed under the direction of Milo B. Williams, chief engineer, assisted by John R. Jahn, Ernest Fortier, Lloyd Brown and others.

Increasing Traffic on Soo Canals

A report by the Dominion Bureau of Statistics of the canal traffic of Canada for June shows how intensively used are the Canadian and American canals at Sault Ste. Marie. In the thirty days there were 3,249 vessels locked through, of 10,069,109 registered tonnage, compared with 2,396 of 7,356,926 tons last year. There were 1,080,720 barrels of flour, 36,457,141 bushels of grain, 9,222,722 tons of iron ore and 3,323,875 tons of coal carried as freight through the canals.

Effect of Curing Methods on Concrete Roads

Tests of Various Methods of Curing Road Slabs to Determine Effects on Wear and Transverse Strength

BY H. J. KUELLING
Construction Engineer, Wisconsin Highway Commission, Madison, Wis.

TO COMPARE field with laboratory conditions this series of tests was run both in the field and in the laboratory using like materials cured in a similar manner so far as practicable. The following methods of curing were selected:

1. Sodium silicate, applied with a pail and old floor brush, coating the entire surface uniformly. As stipulated by the company supplying the material, a mixture of three parts silicate and one part of water was used.
2. Calcium chloride, flake, applied three pounds per square yard of surface. This was applied with a shovel and spread out uniformly.
3. Calcium chloride, granulated, applied three pounds per square yard of surface.
4. Earth covering about three inches thick, kept constantly moist for two weeks.
5. Hay covering, about five inches deep, loose measure, kept moist for two weeks.
6. Straw covering, about five inches deep, loose measure, kept moist for two weeks.
7. No covering on the surface.

For the field operations a road near the city of Madison was chosen as it was reasonably close to the laboratory. The party was equipped with a light truck, scales, balance, thermometers, molds and small tools.

Method of Testing—Six slabs 4½ x 8 x 19½ in. and six 6 x 12-in. cylinders were made from concrete cured by each of the above methods. Only one specimen was made from any given batch of concrete, but a slab and a cylinder were always made from the same batch.

The slabs were made by placing steel molds against the side forms of the road, the slab being removed after the concrete had set and the road form was removed. The holes resulting were filled the next day with standard concrete. After removal the slabs were placed, face upward, upon the adjacent pavement and cured by the same method as the roadway section. The sodium silicate and calcium chloride specimens were surrounded by dirt to prevent loss of moisture from the sides.

The cylinders were filled in sections of one-third, with material taken from different portions of the batch. Each layer was puddled with about twenty-five strokes of a half-inch rod. The top of the mold, after finishing and partially setting, was protected against evaporation by a canvas covering. The pasteboard forms, in which the cylinders were cast, remained attached to the cylinders until the day previous to breaking. They were marked with the identification of the corresponding slab.

The cylinders for the sodium silicate and calcium chloride were protected by dirt to prevent exposure to sun and air. The others were covered with their respective curing agents.

At fourteen and twenty-one days the slabs and cylinders were removed to the laboratory and tested.

Besides making the slabs and cylinders, the field party determined moisture contents, weights, proportions, and consistencies of the materials and resulting concrete.

The party also secured the samples of materials for the laboratory tests. These consisted of a sack of cement, about 250 lb. of fine aggregate and 375 lb. of coarse aggregate, each taken from the stock piles near the mixer at the time the respective field slabs and cylinders were being cast.

On reaching the laboratory with the material samples, colorimetric tests were run on the fine aggregate; the weight per cubic foot of both fine and coarse aggregate was determined after drying; a sieve analysis was run, and briquette tests were made on one part of cement to three parts of fine aggregate. Six slabs and six cylinders were made from each sample of aggregate and cement. For comparison purposes so-called "standard" specimens were made, which consist of a good limestone, a good sand and a mixture of three brands of cement, these materials all being in constant use in the laboratory. Great care was used to make these under as nearly equal conditions as possible, only one slab and cylinder being mixed at a time.

After one day in the molds, the cylinders were placed in the moist closet until the day of testing. The slabs to be cured with sodium silicate and calcium chloride were placed on a platform adjacent to the moist closet. The sides, ends and bottoms of these were sealed with sodium silicate and the top only cured in its respective manner. The slabs to be cured with hay, straw and dirt were placed in the moist closet, covered and moistened daily. The slabs and cylinders which were to have no covering were placed in the permeability room which had an average temperature of about 75 deg. F.

The slabs were withdrawn from the moist closet after 14 and 18 days. The 14-day sets were tested on removal, but the others were allowed to stand three days at room temperature.

The cylinders were kept in the moist closet 14 and 21 days and tested immediately.

In the field, six slabs and six cylinders were made of each method. Three were tested when 14 days old and three when 21 days old. The 21-day period was chosen because it is the standard of the Wisconsin Highway Commission, and the 14-day period was chosen to determine what effect the shorter period of curing had upon the strength results.

Sections cured by sodium silicate and calcium chloride were not touched after having the curing agent applied, which was about twenty hours after pouring. The sections covered with dirt, hay and straw were kept moist for 14 days, the standard Wisconsin practice. Sections not covered were exposed to the normal existing weather conditions, which had an average temperature of 72 deg. F.

The specimens, both field and laboratory, were broken under standard laboratory practice. The cylinders were crushed in a 100,000-lb. testing machine. The slabs were rattled in an abrasion machine quite similar to a standard brick rattler. Six slabs were tested at once, being fastened in like staves in a barrel. One stave was a dummy with slots in it to permit the accumulated dust to escape during the rattler operations. The charge consisted of 150 lb. of small iron shot and 50 lb. of large shot.

The charge was given 1,800 revolutions in a clockwise and 1,800 revolutions in a counter-clockwise direction at a speed of thirty revolutions per minute.

In making the transverse tests, the specimens were supported on rocker bearings over a 17-in. span with the worn side of the slab down. (Slabs were first rattled and then broken for transverse strength.) The table shows the test results.

Results and Conclusions—From this table can be assembled various other tables, such as a comparison of strengths at 14 and 21 days of the various materials and curings; a comparison of field with laboratory specimens as to wear, transverse strength and compressive strength. These tables have all been drawn up, but it was felt that they would make this article too lengthy.

WEAR AND STRENGTH OF PAVEMENT CONCRETE CURED BY DIFFERENT METHODS

Age in Days	Weight Lost, Per Cent	Mod. of Rupture, Lb.	Ult. Str. Cylinders, Lb.	Character of wear in rattler test of slabs
Sodium Silicate Covered (Field Specimens)				
15	6.8	529	1,762	Even. One grooved end
22	7.5	598	1,648	Two uneven. One even
(Laboratory Specimens)				
14	18.3	290	2,381	Uneven. One broke
22	16.3	404	2,766	Uneven. Two broken
14	15.0	380	1,818	Uneven. Two broken
22	16.8	470	1,844	Uneven. One broken
Calcium Chloride Covered (Field Specimens)				
14	10.2	686	1,969	Uneven. One grooved
21	9.4	623	1,873	Uneven
(Laboratory Specimens)				
14	8.5	497	3,164	Uneven
21	12.4	392	2,367	Uneven. One broken
14	16.5	537	1,713	Uneven
21	9.3	481	1,657	Uneven
Hay Covered (Field Specimens)				
20	8.2	418	1,871	Uneven
21	10.5	333	1,867	Uneven
(Laboratory Specimens)				
14	12.2	361	1907	Uneven
21	13.9	360	2238	Uneven
14	12.5	476	1661	Uneven
21	10.7	510	1936	Uneven
Straw Covered (Field Specimens)				
19	7.8	420	2,037	Even
20	8.2	505	2,255	Uneven
(Laboratory Specimens)				
14	11.5	451	1,932	Uneven
21	10.9	490	1,967	Uneven
14	12.7	449	1,553	Uneven. One broken
21	11.4	517	1,546	Uneven
Dirt Covered (Field Specimens)				
17	7.6	593	2,173	One even. Two uneven
21	3.6	609	2,309	Two even. One uneven
(Laboratory Specimens)				
14	8.1	442	2,647	Uneven
21	8.4	559	3,076	Uneven
14	12.3	399	2,082	Uneven
21	11.7	572	1,764	Uneven
No Covering (Field Specimens)				
14	8.9	491	1,992	Uneven. One grooved
21	6.0	441	2,013	One even. Two uneven
(Laboratory Specimens)				
14	19.0	...	2,357	All three broken
21	19.6	...	2,643	All three broken
14	18.7	...	1,787	All three broken
21	18.9	480	2,245	Uneven

Note: In each case the figures are an average of three specimens except where slabs broke in the rattler and the modulus figures represent two specimens or less.

The consistency of the concrete was in most cases drier for the laboratory than for the field mixes. It is felt, however, that the amount of water retained in the field slabs when setting took place was less than the amount retained in the laboratory specimens, on account of the finishing operations and the weather action.

The important effect of the absorption of the subgrade will be appreciated from some laboratory tests which were made in 1921. Half of the specimens were bedded on sand and half made in tight cast-iron molds. These tests show that the slabs with sand bottoms were 5 per cent stronger in the transverse test and lost 5 per cent less in the rattler than the slabs made in the tight molds. Because of these reasons one would expect the field slabs to prove more resistant to wear and stronger in the beam test than the laboratory slabs, a condition which is true in nearly every case.

The field experiments show that the calcium chloride covered specimens give the best results for transverse

strengths in both the 14- and 21-day periods of curing, though closely followed by the strengths of the dirt covered specimens. The latter gave, on an average, a more resistant surface for both periods. Not so marked a difference was noticed between these two types of curing in the laboratory specimens.

In both the field made and laboratory specimens, cured by calcium chloride, the modulus of rupture dropped considerably at 21 days. Because of this rather startling defect some studied consideration should be made before the acceptance of this material as a curing agent.

Where dirt is available, it is preferable to use this material for a curing agent, rather than hay or straw. The latter could be used when dirt is not available.

By no means, as is clearly shown by these tests, should a newly poured surface be exposed to sun and winds.

It is evident from these tests that the concrete had gained sufficient strength to warrant the opening of the road to traffic at the end of fourteen days without possibility of doing injury to the pavement. In cases of extremely heavy vehicles damage might be done, but not with ordinary traffic.

Brick on Waterbound Macadam with Penetration Curb

Construction Methods on Twenty-Mile Texas Road —Curb Work Unique—Ten-Months' Traffic Develops No Defects

BY C. H. HENNING

State District Engineer, Texas Highway Commission

METHODS unusual in character and thoroughness have been employed in building a 20-mile brick road in Eastland County, Tex. This road leading from Granger to Cisco has a waterbound macadam base surfaced with vertical-fiber, asphalt-filled brick, edged with curbs of penetration macadam. It is a federal-aid project, F. R. Sexton being the government engineer

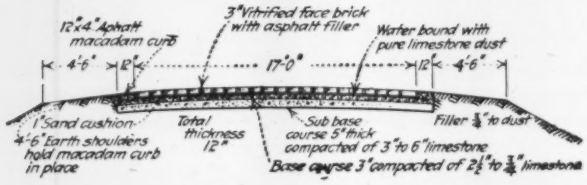

12"x4" Asphalt macadam curb
3" Vitrified face brick with asphalt filler
Water bound with pure limestone dust
4'-6"
12"
17'-0"
12"
4'-6"
1" Sand cushion
4'-6" Earth shoulders hold macadam curb in place
Total thickness 12"
Sub base course 5" thick compacted of 3" to 6" limestone
Filler ¾" to dust
Base course 3" compacted of 2½" to ¾" limestone

FIG. 1—CROSS-SECTION OF BRICK ROAD WITH PENETRATION CURBS

in charge, and is financed with 45 per cent county funds and 55 per cent state and federal-aid funds.

As shown by the drawing, Fig. 1, the roadway is 28 ft. wide on fills and 38 ft. wide in cuts. The base is 8 in. of thoroughly compacted macadam 19 ft. wide, with a 2-in. crown. Upon this base and a 1-in. sand bedding course is laid a surfacing of 3-in. vertical-fiber, vitrified brick to a width of 17 ft. Asphalt filler is applied, with the thinnest possible coat remaining on the surface, after which coarse sand is applied.

On each side of the 17-ft. brick surface and on top of the remaining foot of 8-in. base a 4-in. asphalt macadam shoulder is constructed. This shoulder is 1 ft. wide and is designed to serve in place of the usual curb. Outside of this shoulder on both sides of the pavement the earth berm, 4½ ft. wide, is brought to grade. On about one mile of the road, and principally at turn-outs and intersections, a 12 x 12-in. concrete curb has been substituted for the asphalt-macadam header.

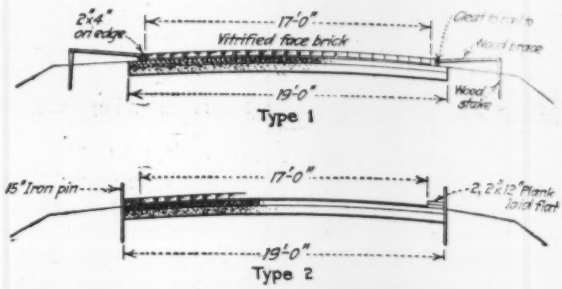


FIG. 2—TWO TYPES OF FORMS FOR SETTING BRICK AND BUILDING CURBS

Braced about every 8 lin.ft. in either case. Templet is pulled along on top of forms to adjust sand cushion, then brick are laid and rolled. The forms are then moved back one foot and asphalt macadam laid, asphalted and rolled. Then the brick are asphalted and covered with coarse sand. Form system No. 2 has proved the better.

Base Construction—Among the more interesting features of the construction is the thoroughness with which the macadam base is prepared. The subgrade trench is cut 19 ft. wide, excess dirt being pushed out for earth shoulders. The trench is then rolled until thoroughly compacted, and lined up. Upon this subgrade is placed a course of sledged limestone sized from 3 to 6 in. in such quantities as to make 5 in. after being thoroughly rolled. Upon this is placed a second course of crushed limestone sized from 2½ to ¾ in. in sufficient quantities to make 3 in. after filling the voids in the larger stone and being compacted. Upon this is placed enough fine material (from ¾ in. to dust) to fill all voids in the second course. This application is broomed in dry and care is taken to fill all voids and see that any excess is uniformly distributed.

The whole is then first rolled dry, sprinkled and again rolled until as firm and tight as possible. Upon this a very fine layer (about 2 cu.yd. per 100 sq.yd.) of pure limestone dust is applied and flushed with water and rolled wet until a grout forms in front of the roller in sufficient quantities and of proper consistency to seal all cavities and honey-combed places. Brooms and, in some instances, wood floats are used to secure an absolute grouting of the entire base. After drying for about 48 hours the base is hard enough to hold up a wagon loaded with 5,000 lb. of sand, without showing a wheel mark or horseshoe print.

Wooden forms are then set up on this base 17 ft. apart leaving one foot of base outside on each side. These forms are set to the grade of the finished pavement. Enough sand is then spread to form an approximate 1-in. bedding course. This course is distributed with the templet which conforms to the surface of the finished road. The templet is pulled along on the forms and varies the depth of the bedding course enough to take out any little irregularities there may be in the base. Where variations of more than ¾ in. show up in the base it is raised or lowered enough to allow the cushion to take up the difference. In other words, if the templet runs up on an inch and a half bump it will not ride on the forms even with no sand under it. In such cases the bump has to be cut down enough to allow the templet to ride the form and still have some bedding sand between it and the base. In

FIG. 3—MACADAM BASE BEFORE WATERBINDING WITH LIMESTONE DUST

case of a low spot too much bedding course will show and a little limestone dust has to be added, wetted and hand-tamped until the bedding course is not too deep.

After a short time the crew developed skill to the degree that it could finish the base practically to grade with the use of tees, and very little trouble was experienced thereafter when the templet was put in operation. The faithful use of the templet guarantees a finished surface as good as the average on a concrete base.

Pavement Construction—Two systems of wood forms have been used, the second proving much more practicable and probably the better. The first system, Fig. 2, consists of bracing a 2 x 4-in. timber on edge from the outside by means of wooden stakes driven into the dirt shoulder, the brace running from the stakes to a nailing strip cleated onto the 2 x 4 timber. The second system, Fig. 2, consists of laying two 2 x 12-in. planks flat and driving steel pins against the outside edge to hold the line. In either case the forms are set to finish grade, and it is sometimes necessary either to shim under them a little or, if there is a bump, take the base down a little. This second system gets away altogether from the use of nails and is a little more rigid. While the first cost of lumber is higher, the same plank can be used over and over again until, in the end, it really is cheaper. In either case the forms are braced every 8 ft.

After the forms have been set and the bedding course shaped the brick are set, rolled, inspected and culled. Before the brick are asphalted the forms are moved back a foot on either side, rebraced and the 1-ft. asphalt-macadam shoulder built. First, a 3-in. course of 2-in. crushed stone is tamped in and 1 gal. per square yard of asphalt is applied. This layer is then brought almost to grade with 1-in. crushed stone and again well tamped. Another gallon per square yard of asphalt is applied and the surface is brought to grade with ¾-in. clean limestone chips, and thoroughly rolled with a five-ton tandem roller.

The brick surface is then flushed with asphalt behind the shoulder gang instead of in front. This keeps the forms from getting covered with asphalt when the brick are flushed. To keep the forms clean while pouring the shoulder they are removed after the first course of shoulder rock has been tamped into place. The dirt shoulder is thrown up into place when the forms are removed and the macadam shoulder and dirt shoulder are rolled at the same time. In short, the shoulder and berm are built as nearly as possible in one continuous operation, the idea being to keep them completed just in front of the flush-coat gang on the brick.

After the brick have been properly filled and sanded, all excess forms and material are moved ahead. The road is opened to traffic, and a team outfit comes along bringing all earth shoulders to grade, straightening up ditches, and in general putting on all the finishing touches.

The bricks were hauled and stacked in advance of the brick-laying gang on both sides of the road where possible, and then delivered by hand to the brick setter, each man carrying four bricks at a time. The narrowness of the road made the use of conveyors of little advantage.

It took about twenty teams and ten extra men, a roller, water wagons, etc., to build 600 lin.ft. of base a day in addition to the gang engaged in crushing the rock. Eight teams and eight extra men were kept busy hauling and stacking the brick for a day's work.

FIG. 4—ROLLING BRICK AND BUILDING CURBS

Ten men carried the brick to the setter. There were two batters, three men working on the bedding course, and two teams hauling sand. Ten more men were engaged in filling the brick and constructing the asphalt-macadam shoulder. In addition, an outfit of six or seven teams was kept busy putting on the finishing touches. Work was started Feb. 15, 1922. Three crews, as outlined, were kept busy all of last summer and fall. One crew was worked in 1923.

Some of the road has now been open to traffic for about ten months and if any change can be noticed it is that it is getting smoother. It is stated by users of the road that it is as smooth as a city pavement on a concrete base. There were two connections to city pavements that settled just a trifle where, to meet the grade, a little too much sand was used in the bedding course. This was remedied by building up the base a little and cutting down the depth of the bedding course.

All work was performed under the direction of F. P. Sexton, federal highway engineer, C. H. Henning, state district engineer, and W. R. Eccles, engineer for Eastland County. The construction was in charge of P. B. Keller, superintendent of Smith Brothers, Inc., general contractors, of Dallas, Tex.

Paper Company Completes Power Plant on the Hudson

Unusual Geological Conditions of the Site—Self-loading, Multiple-Arch Dam—864-ft. Spillway—Large Concrete-Lined Canal—Reinforced-Concrete Penstocks, Scroll Cases, and Draft Tubes

FORTY THOUSAND more electric horsepower has been added to the available supply in northern New York by the completion of the International Paper Co.'s Sherman Island hydro-electric development, on the Hudson River near Glens Falls, N. Y. This plant uses the total head between the tailwater elevation of the power plant at Spier Falls and the pond of Champlain Canal Feeder Dam at Glens Falls, an average head of 65 ft. The ultimate installation will be five units of 10,000 hp. each and will utilize at full load a total flow of 7,600 sec.-ft.; but on account of the present unregulated flow of the Hudson River only four units have been installed. Electric current is generated at 6,600 volts and transmitted at 114,000 volts to the trunk distribution system of the Adirondack Power & Light Corp.

The outstanding features of the development are the unusual geological conditions encountered and overcome. The main dam is founded on a bed of boulders and gravel, the headrace canal is excavated through fine sand, and the power house is set in a glacial flour approximating quicksand. It is located just where the Hudson River comes out of the Adirondack Mountains into the broad valley which it follows to the sea. The bottom of this valley is filled with glacial deposits of great depth. The dam is on the edge of this valley just where the steep granite rock slopes of the two peaks that flank the river dip sharply under the glacial bed. The two extremities of the dam are built on this rock and the spillway channel is excavated through it but the main portion of the dam is built on glacial deposits, a firm mass of boulders, sand and coarse gravel of unknown depth.

This formation practically precluded the idea of using a spillway dam across the river or a gravity type reservoir dam, and, as the formation of the south bank (the river here runs east) made it possible to excavate a wasteway channel through the solid rock, it was decided to use a non-overflow, multiple-arch dam across the main channel of the river and to use a gravity type section for the spillway which would be on solid rock.

From the site chosen for the dam to the upper end of the feeder dam pool the river runs in a rapids about

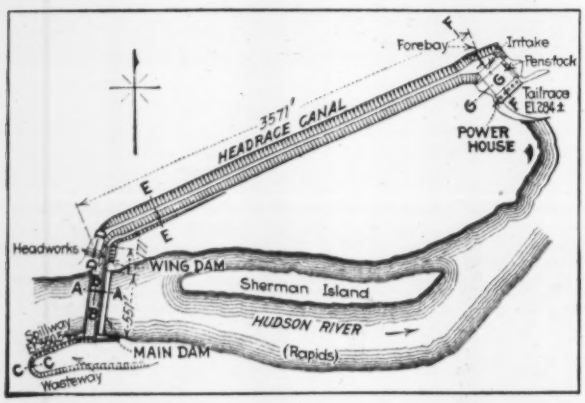


FIG. 1—GENERAL PLAN OF THE SHERMAN ISLAND DEVELOPMENT

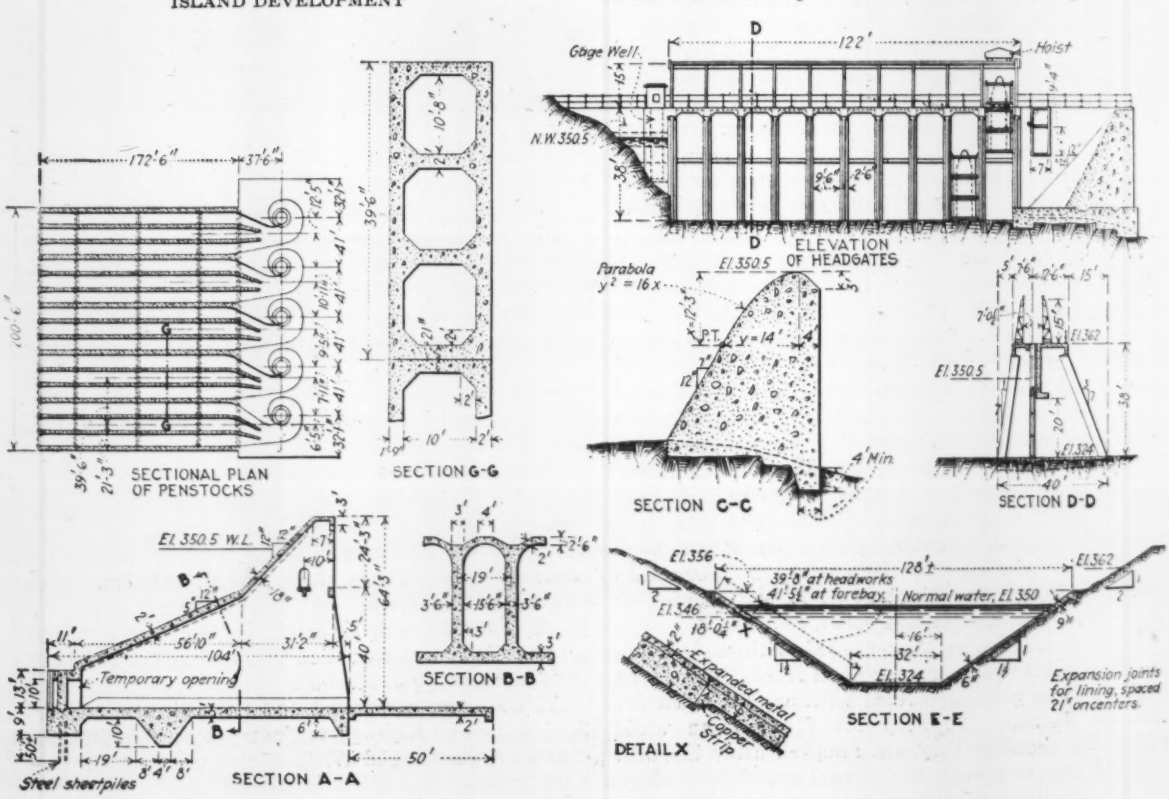


FIG. 2—DETAILS OF THE STRUCTURES OF SHERMAN ISLAND DAM AND CANAL

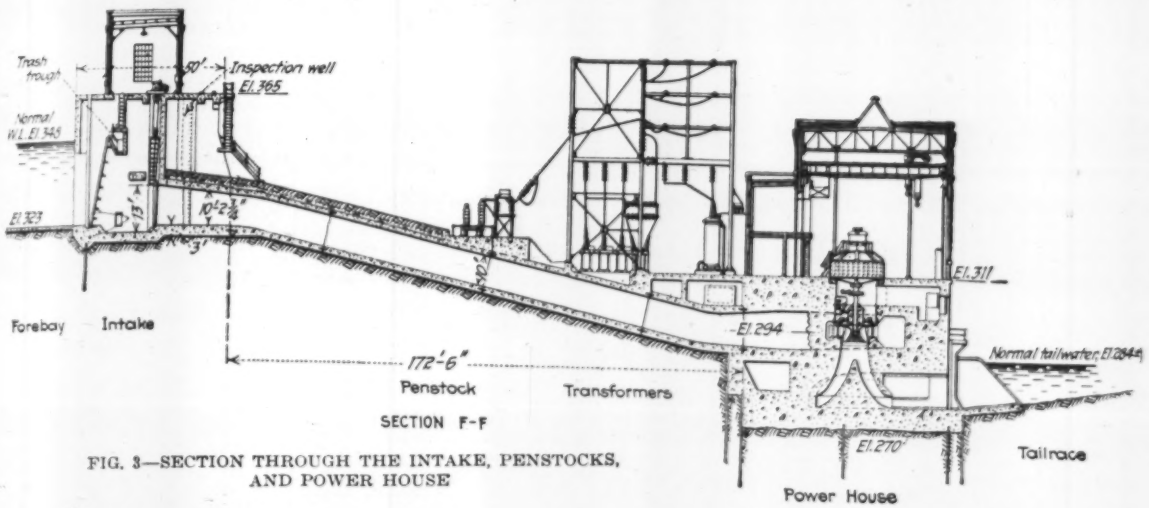


FIG. 3—SECTION THROUGH THE INTAKE, PENSTOCKS, AND POWER HOUSE

3,000 ft. long, falling 19 ft. To use this 19 ft. of head it was necessary to do one of two things, either locate the power house at the dam and excavate a long tailrace channel in the unstable material found underneath the boulder blanket of the river bed downstream from the dam, or carry a canal along in the bank of the north shore and build the power house at the upper end of the pool. The latter plan was adopted as the formation of the bank lent itself to such a development. Fig. 1 gives the general layout of the project.

Details of the Design—The main dam across the river channel is of reinforced concrete, 551 ft. long and has a maximum height of 70 ft. from the bottom of the floor to the walk. It is a multiple-arch type of dam as shown in Sections A-A and B-B, Figs. 1 and 2. The buttresses supporting the arches are placed upon a heavily reinforced floor slab which distributes the weight of the dam over the whole foundation area, thereby reducing the unit load to a safe amount. The decrease in the slope of the back from a 12:12 slope to a 5:12 slope was made in order to increase the weight of water upon the dam and, by the consequent widening of the floor, to increase the contact with the boulder bottom thus gaining more stability against sliding. As an additional precaution, the floor of the dam and the 50-ft. concrete apron below it have been covered with a layer of sand about 20 ft. thick. This increases the weight and also serves as a protection in case of overtopping. Overtopping is, however, highly improbable as the height of the dam above the spillway is such that it would require a flood 50 per cent greater than the record flood of 1913 to overtop it.

FIG. 5—INSIDE OF COFFERDAM NO. 1 SHOWING THE CHARACTER OF THE RIVER BOTTOM

In order to reduce the upward pressure on the dam to an average of not more than 30 per cent of the active head, a double row of Lackawanna steel sheet piling 50 ft. deep was driven along the upstream toe of the dam; and after the dam was completed the bottom of the pool

FIG. 4—GENERAL VIEW OF THE SHERMAN ISLAND DEVELOPMENT
Showing the spillway and main dam at right and top of canal lining from center to left; powerhouse at extreme left.

immediately above the dam was filled with fine sand. Actual measurements of the pressure since the pond was filled show that the pressure is well below the prescribed limit.

The thickness of the arch ring in the main dam is notable. It is only 18 in. in the upper section and 24 in. in the lower section. These shallow thicknesses were used in order to increase the elasticity of the arches and to reduce to a minimum the stresses due to shrinkage and temperature changes.

The spillway is all on solid rock and is of mass concrete of gravity section. It is horseshoe shape in plan to give a weir length of 864 ft., the length required to take a flood of 100,000 sec.-ft., with a margin of 2 ft.

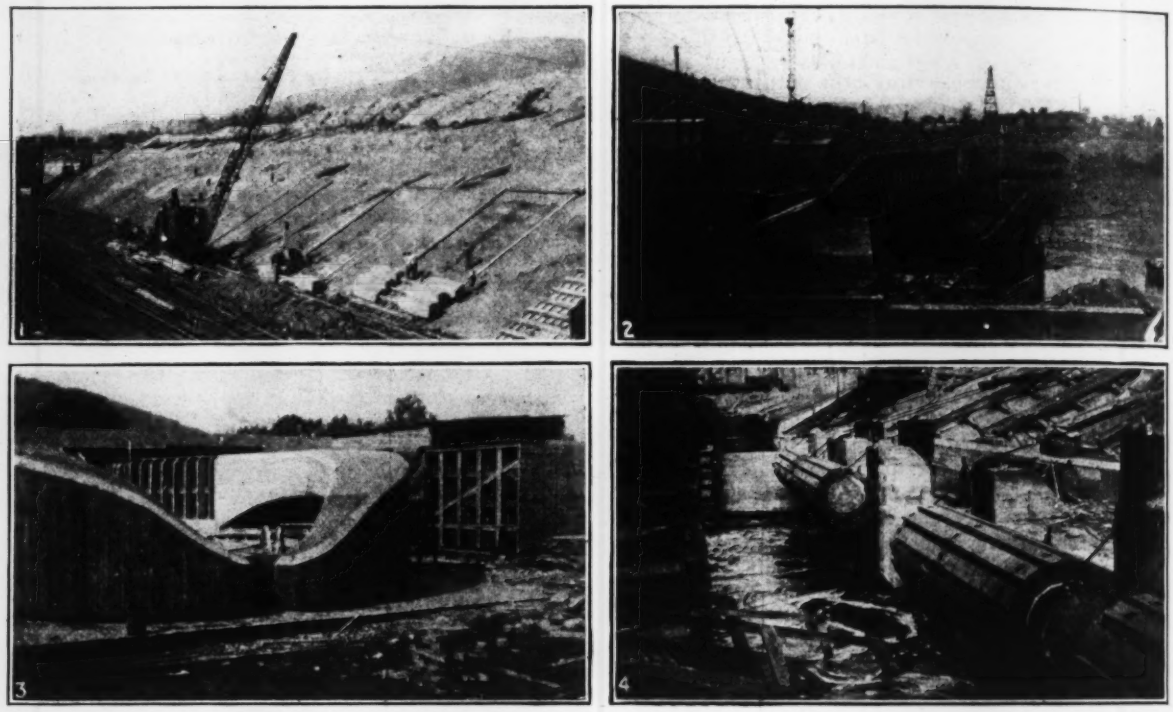


FIG. 6—DETAILS OF THE WORK DURING CONSTRUCTION

Showing (1) Pouring the 6 in. concrete slabs for the canal lining. (2) Buttress work on the main dam. (3) Forms for the turbine draft tubes. (4) Temporary roller gates for closing the last openings in the main dam.

below the top of the main dam. The wasteway channel was so designed that under no circumstances would the weir be submerged. There are seven sluiceways through a bulkhead section built into the spillway for use in case it is necessary to partially empty the pond.

At the north end of the dam is a wing dam 171 ft. long of gravity section built on solid rock. It closes the gap between the main dam and the south embankment of the canal and forms the east abutment of the headworks. The west headworks abutment is against the side of the short rock channel that forms the upper end of the headrace canal. The headworks structure is of reinforced concrete built on solid rock and is designed as a dam sustaining a head of 35 ft. It is shown in detail in Fig. 2. The novel feature of this structure is the design of the gates. In view of the fact that they need to be lowered into place only when it is necessary to clean or repair the canal and need not be quick operating when refilling the canal, it was decided to make them as simple as possible and to introduce the minimum amount of obstruction in the channel by making it possible to raise the gates entirely out of the channel when not in use. They are of reinforced concrete with angle irons to protect the edges and make tight fitting joints. Each of the ten gates is made in three sections 7 ft. x 10 ft. 2 in. and 18 in. thick, fastened together by manganese bronze links and pins. The link between the middle and the upper section is slotted to provide a 14-in. opening for filling the canal and for supporting the gate in its raised position. These gates are raised and lowered by a 20-ton electric hoist mounted on a craneway running the full length of the headgate structure. The gage well and the pump well are located in this structure as is a log gate for driving timber through the canal.

The headrace canal, with the exception of the first hundred feet, is excavated through a glacial deposit which ranges from coarse gravel to quicksand, most of it through a moderately fine sand. For this reason all but the short rock section at the upper end is lined with concrete up to a level of six feet above the spillway elevation. Above this level the slope is riprapped to protect it against scour during the short duration of floods which might go above it. The forebay is lined with concrete to this higher level on account of the surge. The details of the canal are shown in Fig. 2. The slab is reinforced with expanded metal mesh to concentrate the expansion in the expansion joints. It is built up in 21-ft. sections, with construction joints at the center and sides of the floor and 40 ft. up the slope where the thickness is increased from 6 to 9 inches. Each joint is closed with a 6-in. copper expansion strip.

FIG. 7—THE CANAL AND HEADGATES

Top of main dam can be seen beyond headgates; concrete mixing plant under temporary trestle at center of the canal.

This design was used on account of the need for greater flexibility in the lining of the canal and it was hoped that there would be very little loss through the joints, but during construction a stratum of water-bearing sand was encountered along the inland side of the canal which made it necessary to leave openings through the lining to take care of the water. After the lining was completed an attempt was made to close up these openings by grouting, but it was not entirely successful and after the canal was filled it was found that there was a loss of about 5 sec.-ft. As the machinery in the power house was not ready for operations it was decided to empty the canal to make observations of the lining. The gates were opened and the canal emptied in about 4 hours. After the water was out of the canal a section of the lining about 1,000 ft. in length on the inland side was found to be damaged in places and other places pushed out into the canal. This was undoubtedly caused by a hydrostatic pressure built up between an impervious layer and the canal lining. Repairs were made by replacing the damaged portion of the lining, adding concrete in heavy steps along this 1,000-ft. damaged section, together with a single step along the toe of the slab at the river side, and concrete struts from side to side laid on the bottom. In addition to this numerous weepers were placed in the bottom of the canal. These consisted of 4-in. pipes carrying simple lift valves at the top. Furthermore, all the construction joints throughout the canal were carefully filled with gunite. Since these repairs were made the canal has been refilled and no abnormal leakage has appeared.

The forebay dam is built on sand. It is of reinforced concrete with a heavy bottom slab and 3-ft. and 3 ft. 6-in. buttresses at 10 ft. face to face. It is provided with a steel sheet pile cutoff 15 ft. deep. There is, however, little possibility of any uplift on this structure as the lining of the canal is connected to it by watertight joints similar to those used in other parts of the canal. Moreover, the ground drops away in front of the dam insuring proper drainage. The intake works are made an integral part of the central portion of the forebay dam as shown in section in Fig. 3. There is a log-way at the east end which runs down to the river below the power house. An interesting feature of the intake is the trash trough along the top of the trash racks shown in Section F-F. It runs the full length of the structure and empties into the log-way and is provided with a 12-in. valve at the upper end for flushing it out.

Fifteen reinforced-concrete penstocks, built in groups of three, have their upper ends in the 10-ft. spaces between the buttresses. They are closed with Broome caterpillar sluice gates operated by electric hoists situated in the gate house on top of the dam. As an emergency measure stop-log grooves have been cast in the concrete in front of the trash racks.

FIG. 8—UPSTREAM SIDE OF THE DAM AND SPILLWAY

Showing, left to right, cement shed and stone stockpile, mixing plant, part of the headgates, main dam and wasteway channel.

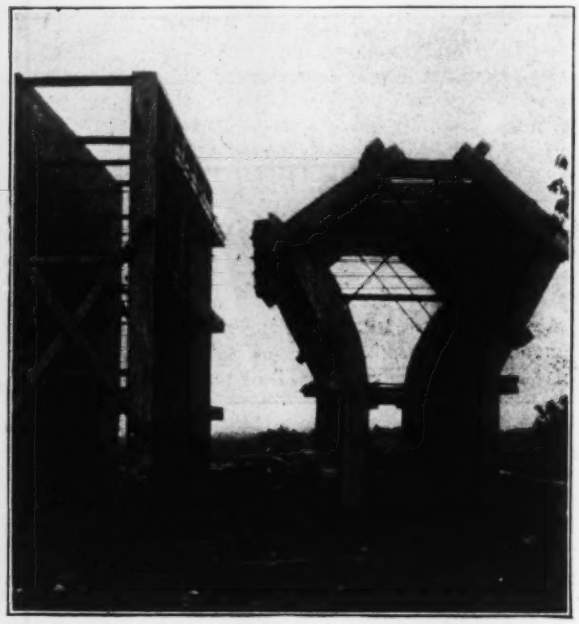


FIG. 9—BUTTRESS FORMS ASSEMBLED READY TO BE SENT OUT TO THE DAM

The penstocks are 10 ft. x 10 ft. 8 in. in section and 172 ft. long. They are heavily reinforced and have a minimum wall thickness of 18 in. Each group of three serves one turbine as shown in section in Fig. 2. As the whole penstock structure is built on sand, some of which is soft, it is divided up into separate sections by longitudinal and transverse joints. Longitudinal joints are made between the groups of three, and the five transverse joints are closed with lead strips, and in addition are calked with tar and oakum on the inside. The inner surface is waterproofed with an iron compound.

The Power House—Test shafts and borings made at the power house site indicated that quicksand underlay the whole area. The problem of confining this sand was solved by dividing the foundation area up into ten box sections by steel sheet piling driven to 25 ft. below subgrade. These sections act as sand columns transmitting the load to a safe depth. To take care of the unbalanced horizontal load and to prevent squeezing out of the material in front of the power house the tailrace apron was carried out across the light sand bed about fifty feet to a point where gravel was encountered in the river bed. Heavy buttresses were carried up from this apron to the side of the power house. Observations were made on the power house foundation during construction to check the settlement. It was progressive during the pouring of the great mass of concrete in the foundation and draft tube blocks but since these were completed there has been no settlement. Fig. 3 shows the power house in section. The ultimate installation will be five 10,000-hp. vertical turbines. The scroll cases and the Moody spreading draft tubes are of concrete.

The superstructure of the power house is of brick and steel with a gypsum roof. A transverse traveling crane of 50 tons capacity serves the whole generator floor and reaches the standard-gage railway track where it enters the west end of the building.

Construction—The construction work started in November, 1920, with the grading and laying of a 6½-mile railroad from Glens Falls to the camp site. Portable and semi-portable frame buildings were put up for the main camp, and a group of cottages which will later be used for the permanent employees was erected for the use of the construction staff. The camp was provided with a septic sewage system and with a duplicate water supply, a drinking water supply from a small reservoir in the hills back of the camp, and a general supply pumped from the river to an elevated tank. Electric current for lighting and power was brought to the site by a 6-mile transmission line from Glens Falls.

The construction camp was equipped with a machine and blacksmith shop, air compressors, sawmill, woodworking shop, and storehouses. These were all located along the standard-gage railway tracks. A 1,400-ft. cableway was built from a central point in the camp to a similar high point on the south shore, parallel to and above the center line of the main dam.

In the spring of 1921 two bridges with stone-filled crib piers and I-beam stringers were built across the river, a double-track structure above the dam site and a single track one below. Cofferdam No. 1, 350 ft. long by 250 ft. wide, at the north side of the river was driven outside the line of the bridge. The sides of the cofferdam were constructed of a single row of Lackawanna steel sheet piling, supported by three rows of wales which in turn were held by the crib pier and the intermediate struts.

The central concrete mixing plant and the rock-crushing plant were located on a natural terrace about 25 ft. above normal water level on the north river shore above

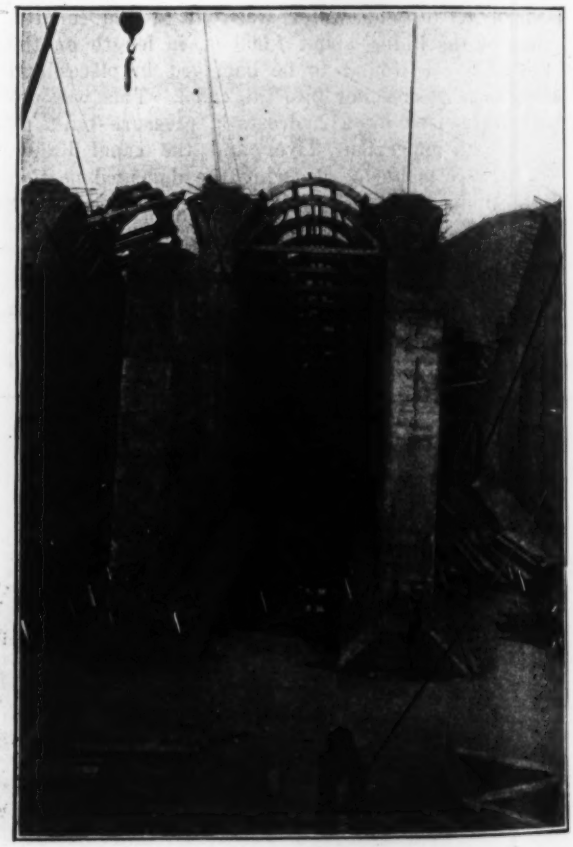


FIG. 10—DETAILS OF THE BUTTRESSES
Showing method of framing for the arch rings.

FIG. 11—THE FOREBAY DAM, PENSTOCKS AND POWER HOUSE
Showing the formwork for the penstocks.

the dam site. Rock for the crushing plant was brought from the excavation for the spillway channel on the south shore. The immediate needs of the mixing plant were supplied by one belt conveyor, and a second conveyor delivered the excess to a stock pile up at track level in the camp. Pit-run sand from the canal cut was supplied to the mixer from the high-level tracks. Cement was brought in bulk from the Glens Falls Cement Co. and was delivered in four hopper-bottom cars specially roofed for that purpose. This cement was dumped into large storage bins built under a spur of the high-level tracks and was fed to the mixing plant bins by a belt conveyor. The central mixing plant had two one-yard mixers equipped with Johnson proportioners for proportioning by weight. All the equipment, crushers, belt conveyors, screens, mixers, air compressors and large pumps were electrically driven. The concrete for the portion of the dam near the mixing plant was spouted from a tower at the mixer but for the greater part of the structure it was deposited from buckets moved by flat cars or from a spouting plant built in a gantry traveler and supplied by buckets carried out on the cableway.

Most of the concrete formwork was done at the woodworking shop in the camp on the high level and was sent out to the dam on the cableway. All reinforcing material was distributed in the same way from a storage yard located under the cableway along one of the tracks in the camp.

During construction of the north half of the dam openings were left between the buttresses at the upstream side of the dam as shown in Section A-A, Fig. 2. The idea of these openings was that as soon as the concreting of this half had been carried above high-water level the cofferdam could be cut and the river allowed to flow through these openings while the south half of the river was shut off by cofferdam No. 2 after the flood period of 1922. Four similar openings were left in the south half of the dam when it was built and these openings were equipped with temporary roller gates. After the main dam and the spillway had been completed, and during the low water of the fall and winter of 1922-23, the temporary openings in the north half were first closed with stop logs and then concreted up. Then when the dam was in shape to start filling the four roller gates were closed and calked from the downstream side. When everything appeared to be holding satisfactorily under the rising water in the pond these openings were concreted up by means of large steel pipes carried up above the level of the water in the pond.

The headrace canal, with the exception of a short section at the headgates, was all in sand and gravel. It was excavated by dragline and steam shovels approximately to grade and was then carefully finished off to subgrade by hand. This subgrade was used for the bottom of the forms in pouring the lining. The lining was poured in alternate 21-ft. sections, the bottom first then the lower 6-in. slab on the slopes, followed by the upper 9-in. slabs. For pouring the slabs 6-in. or 9-in. stringers were laid up the slope to make the side forms and 26-in. portable panels, held in place by concrete weights, were used for surface forms. The expanded mesh reinforcing was laid on the slopes before pouring started to provide a footing in the soft sand for the

FIG. 12—DOWNSTREAM FACE OF THE COMPLETED DAM
Showing the 20-ft. fill on the floor and apron of the channel section.

workmen. As the concrete was poured this mesh was pulled up into place with hooks.

Concrete for the canal lining was mixed in a plant suspended between the bents of a trestle which crossed the canal. From this 1-cu.yd. mixer the concrete was run directly into 1-cu.yd. buckets on flat cars operated on a double-track railroad laid in the bottom of the canal. Locomotive cranes distributed these buckets to the concreting gangs and also placed form panels.

Cement, sand, and stone for the canal mixing plant were dumped from the deck of the trestle to the bins underneath the track. Latterly, when the main dam was finished and the site of the central mixing plant was submerged, a tower was erected at the side of the canal plant and concrete was mixed there and delivered to cars on the deck of the trestle.

Concrete for the power house and the major part of the forebay dam was handled by train in 2-yd. side-dumping buckets from the central mixing plant to a distributing tower on a high point above the power house and forebay dam. Concrete for the penstocks was mixed in a 1-cu.yd. plant built on a high point at the end of the forebay dam. All concrete was proportioned by weight. The proportions were changed constantly, both on account of the four classes of concrete used and on account of the variations in the pit run of sand and crusher run. Concrete for the massive work was mixed substantially in the proportions of 1:3:6, for the lighter work 1:3:5, and for the light reinforced parts 1:2:4. The canal mix was made about 1:3:2 on account of the difficulty of working the concrete into the 6-in. forms.

Great care was used in the control of the mixing water to see that there was no excess. Samples were taken from the concrete at regular intervals and cast into 10-in. cylinders. These cylinders were cured and then tested at the Rensselaer Polytechnic Institute.

For winter concrete work the sand and stone bins were equipped with steam coils and the water was heated. By this means concrete was usually delivered at the forms around 50 deg., the early morning batches being as high as 90 degrees. Temperature tests were taken on all cold days and a check was kept on the temperature of the concrete in place for periods extending over weeks in some cases. All exposed work was protected with hay and paper.

Generally the temperatures were higher on the day immediately following placing and then fell off slowly. One large section of mass concrete in the wing dam poured on January 21 never registered an internal temperature below 34 throughout the winter.

The turbines were designed and built by Wm. Cramp & Sons, and the electrical equipment by the General Electric Co.

The general design was made by A. H. White, chief engineer of the International Paper Co. H. deB. Parsons was consulting engineer and designed the main dam. The structural details were worked out by E. E. Halmos, designing engineer, and S. A. Thoresen of the firm of Parsons, Klapp, Brinckerhoff & Douglas. The construction work was done by the Parklap Construction Corp., under the direction of W. J. Douglas, president, and E. E. Halmos. The field staff consisted of E. A. Little, manager, W. F. Barnes, general superintendent, and G. Miller, supervising field engineer. H. M. Hale was resident engineer for the International Paper Co.

The Truth About Civil Engineering

A Talk Broadcast from W. J. Z[illegible] New York City, by Frank C. Wight, Mana[illegible] Editor Engineering News-Record. [Printed by Request]

IN THESE days of the silver screen there is no need to tell anyone what a civil engineer is. Every movie fan knows that he is that handsome, though rugged, chap in the nicely pressed khaki breeches and knee boots who bosses a thousand or so roughnecks building a dam in the eucalyptus covered hills back of Los Angeles. His professional activities consist in a few moments' studious attention to a blueprint or two, a short glimpse through some kind of a surveyor's instrument and some hail-fellow-well-met directions to a couple of men working near a derrick. The rest of his time is spent in bashful devotion to the daughter of the New York banker who is financing the dam. Along about the fifth reel the slick-haired lounge lizard who has pursued said daughter all the way from New York, manages somehow to get a nasty-looking bomb over the side of the several hundred thousand yards of concrete that make up the dam, but before the fuse gets in its dirty work to discredit our hero, that gentleman—his pants still neatly pressed—dives overboard, grabs the bomb, swims out with it and hurls it toward a road over which, unknown to him, the villain in a speeding auto is kidnapping the heroine. The bomb explodes, the automobile dives into the crater, the villain dies in such fashion as the censor will permit and the heroine somehow tumbles into the arms of the civil engineer. Fade-out of civil engineer and banker's daughter against background of dam, derricks, and surveying instruments.

This isn't confined entirely to the movies. The civil engineer is in danger of becoming characterized by the artists, both pictorial and fictional, as the great romantic—the successor of the cowboy and the soldier, the exponent of the wide open spaces, the two-fisted man who gets things done but always in the romantic manner, who moves gaily through a picturesque, an unusual, an adventurous life. It is far from a joke to say that the greater number of the recruits to the profession are drawn there by just this appeal.

In marked contrast to this idealized picture of a civil engineer is the too prevalent viewpoint of the big business man, the politician and the banker, the men who handle the strings of the purse into which the civil engineer must dip for the wherewithal to carry on his work. These men are prone to consider the engineer as a sort of higher class journeyman—a mathematician, a surveyor, a draftsman—who deals only with material things; a good enough sort of expert to plan the transformation of steel and concrete and earth and rock into the tunnels, and buildings, and bridges and water-works the world must use, but after all a mechanic with no sense of men or business or beauty. He is necessary to the world, of course, but not one who can ever rise very high in its direction.

Of these two conceptions of the civil engineer, the latter is by far the more offensive. No special harm is done the profession by painting it with an over-romantic brush. Boys who are led to become civil engineers by the adventurous appeal can find sufficient adventure if their youthful ambition that way persists. And if the glamour of adventure wears away, as it does with most, there remains for them that solid work which makes up most of the profession's activities. But the other viewpoint is offensive to civil engineers because it is wrong and because it constantly works to reduce the effectiveness of a profession which, considered properly, could do so much more to improve the conduct of the world's business. It is as a plea for the consideration of the civil engineer as something more than a servant of business and government that this brief talk is intended.

Engineering, in the classic phrase of one of the oldest professional societies, is the directing of the powers of nature to the use of man. That is pretty broad defining and does not help much in an interpretation of the civil engineer. Another and less dignified definition is that an

engineer is one who can do for one dollar what any fool can do for two. But that merely explains motive and does not describe activities. It will help to an exact appreciation of what a civil engineer is perhaps to say that he is one who conceives and executes the structures necessary to man and the services necessary to his health and convenience. Bearing in mind, then, the important dual capacity of both conceiving and executing—he is responsible for bridges and buildings, for tunnels, for roads, railways, canals, for the control and regulation of rivers both as protection against floods and as preservation for power or water supply, be it for drinking water or irrigation, for draining wet lands and for watering those that are over dry, for laying out and maintaining the streets of our cities, for bringing water to those cities and for taking away their refuse.

These are his practical activities; he is, it will be seen, the great satisfier of the physical and material needs of man. For that, however, the civil engineer takes no undue credit for he realizes that civilization is a complicated organism, that each of the many functions has equal importance. The civil engineer is no more necessary than the doctor, the merchant or the farmer for without any of them the organism would either cease to function or at best function very imperfectly.

The civil engineer does, however, take credit for the manner in which he goes about satisfying the needs of humanity. He believes that the underlying principle of his creed and the way he practices that creed entitle him to a better appreciation of his wider capabilities, not because such appreciation would hasten his own advancement but because it would react to the good of everyone.

Honesty and economy are the fundamentals of this creed. The engineer is not vainglorious when he says that he is honest; he is not thanking God that he is not as other men. It is merely one way of expressing the scientific spirit that must govern engineering. From his earliest school days he is taught to pursue the facts and nothing but the facts. He must know the truth and he must utilize only the truth. Those material things he deals with are not susceptible to argument; they will act only according to immutable law. Added to this basic necessity for knowing the facts he must have the faculty of moving from fact to further fact by reasonable processes of thought so that the final result will be as near in accordance to the truth as the frailty of man's mental processes will permit.

It is submitted that the type of mind which is insatiable in its desire to learn the truth and then trained to apply that truth to beneficial ends is one which the world can well use in solving many of the problems not ordinarily associated with civil engineering.

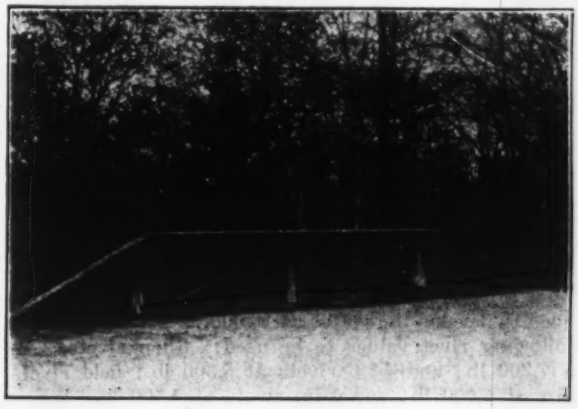
The second part of the engineer's creed is equally important—economy. To do a thing as well as it needs to be done for the least cost consistent with that end. Not to do it cheaply, for that would not be doing it as well as it need be; not to spend money in needless embellishment for that would be doing it better than it need be, but to weigh the necessities and then exactly to satisfy them—this is the engineering ideal. Is not such an ideal needed in our government? Is it not needed in our industries? Is not the man who truly serves such an ideal better fitted to conduct a city than the much vaunted business man whose ideal is profit, whose whole training is based on a judicious assumption of risk and who is satisfied if one successful venture more than makes up the losses from half a dozen unsuccessful ones?

And so we civil engineers make a plea to the rest of you. We are not khaki clad romantics—though some of us do wear khaki once in a while and probably all of us have as much of a romantic and adventurous streak as the next one. We are not those chaps you see out on the road once in a while peeping through a funny looking telescope set up on three legs. Surveying is a necessary but rather elementary part of engineering, though every artist who paints a picture of an engineer sticks him up alongside a thing he fondly considers to be a surveying instrument. We are not rank materialists who are concerned only with the putting together of so much steel and concrete into a usable structure. We are a group of men reared in a stern school of adherence to facts who are touched now and then with the divine spark of imagination which gives you a Brooklyn Bridge or a Catskill Aqueduct. Because of the very nature of that with which we deal we must see clearly if we are to succeed. Because no material thing can be completed without human aid, we must understand our fellow man. Because only those things that pay can be built in this material world, we must appreciate the value of the doller and what it can be made to do. We submit that here is a combination of qualities—qualities, be it noted, of a profession and not necessarily always combined in each member of that profession—which the world has not adequately utilized.

Meanwhile, do not think of civil engineers as mathematicians who possibly make mathematics do things or, at the other end of the scale, as mechanics who have not organized in labor unions. Think of them as practical scientists, as men who come in daily contact with three things, (1) natural forces, (2) man and (3) money. To co-ordinate those three so that they jointly can do the best work is the real job of the engineer.

A Substantial Bridge Railing

WHAT appears like a concrete truss to carry substantial loads in the view herewith, is merely a hand-railing surmounting a concrete arch bridge in a Montreal park. This railing appears capable of holding a fairly heavy vehicle from going overside. Substantial railing construction on bridges and viaducts, as well as on road fills, has been found desirable by many state highway departments and city bridge and street bureaus, but construction as heavy as that shown here is not common.



HEAVY RAIL OF A PARK BRIDGE

Seven Years' Federal Aid Road Work

During the period of federal aid in highway construction, from July 11, 1916, to June 30, 1923, there have been completed 23,297 miles of roads at a final cost of $407,704,641 according to statistics announced by the Bureau of Public Roads. There were under construction on June 30, 14,771 miles of federal-aid highway, with an estimated final cost of $274,080,168, construction on that date being 53 per cent completed. The average cost of all types of the 23,297 miles of highway was $17,500 per mile. On a general average, the figures varying with different types and localities, the cost of constructing has been divided: grading, 22 per cent; surfacing, 58 per cent; structures, 16 per cent; shoulders, 1 per cent, and miscellaneous, 3 per cent.

Design of Earthquake-Resistant Buildings in Japan

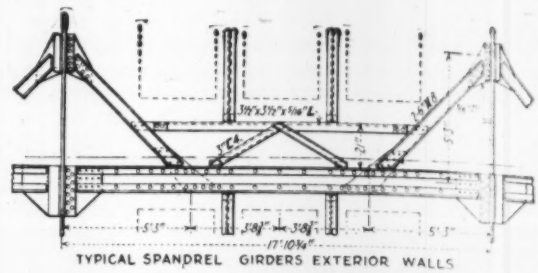
Details Provide Unusual Strength at Column Joints —Heavy Sway Bracing Used—Struts Between Foundation Piers

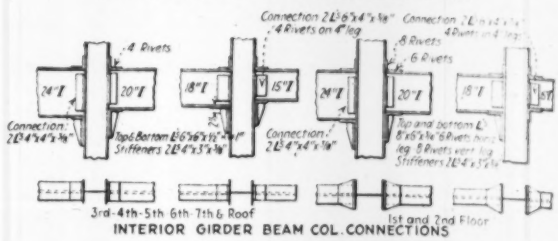
SUPPLEMENTING the notes on structural design of steel-frame buildings in Japan, published in last week's issue, page 434, there are presented herewith typical structural details of the Japan Oil Co. building in Tokyo. This is a seven-story steel-frame structure occupying a ground area of 150x156 ft. and was constructed by the George A. Fuller Co. of the Orient, a Japanese subsidiary of the New York organization of the same name, from designs prepared by Purdy & Henderson, consulting engineers, of New York City, in collaboration with Japanese designers. The details in the accompanying drawings have been selected to indicate the methods employed to make the structure secure against damage by earthquake shocks. These details cover a typical spandrel girder with the heavy knee-bracing of double 6-in. channels between column and girder, heavy column bases with clip angles to engage the reinforcement in the concrete struts which extend in both directions between all pairs of pile-supported concrete piers, the framing plan of a typical panel of the building, and, of particular interest, a typical column splice made up of layers of plates requiring 416 rivets. There are also shown details of the interior girder beam and column connections.

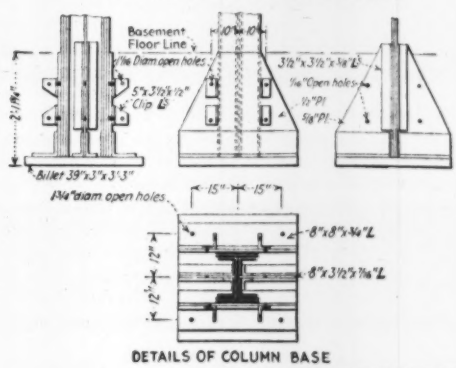
Taken in conjunction with last week's article, the drawings are largely self-explanatory. Of particular interest to American designers is the heavy column splice which places no value on the bearing of one column length upon the other. The assumed loading on column No. 58 at the second floor, the one shown in the accompanying drawing, is 640,000 lb. The following explanatory note appears on the designer's blueprint of the column splices: "Area of splice plates to equal area of column above and sufficient rivets provided to develop the plates at 16,000 lb. per square inch. Following rivet values to be used: Shop rivets, $\frac{7}{8}$-in. at 7,200 lb., and $\frac{3}{4}$-in. rivets at 5,300 lb.; field rivets, $\frac{7}{8}$-in. at 6,000 lb., and $\frac{3}{4}$-in. rivets at 4,500 lb. Where filler plates are required, the number of tack rivets to be equal to 20 per cent of shop rivets. Not less than two lines or more than four lines of tack rivets to be used except at roof splice."

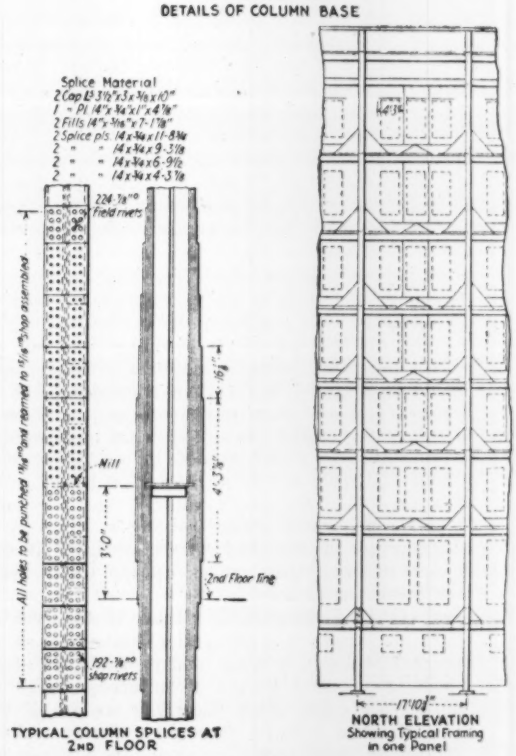
It will be noted that both web and seat connections are provided between girders and columns.

The preliminary indications that all of the three large steel structures in Tokyo—the Japan Oil, the Maranouchi, and the Nippon Yusen Kaisha office buildings—withstood the earthquake of Sept. 1 are confirmed by the following statement issued Sept. 13 by the U. S. Department of Commerce: "American steel and concrete buildings in Tokyo and Yokohama withstood the earthquake shock and are in good condition, according to a cable from Assistant Trade Commissioner G. C. Howard at Kobe. Officials of the Department of Commerce expressed gratification over the first practical demonstration of the effectiveness of the new so-called earthquake-proof factories and office buildings which have been constructed in the past three years. The fact that this construction has proved earthquake-proof is likely to influence adoption of this type in the future."









TO WITHSTAND SEISMIC SHOCK

Structural details of Japan Oil Co. Building in Tokyo, indicating precautions taken to insure strength by heavy sway-bracing, and unusual column splice.

Garbage Piggery and Residue Drying Cheapest for Buffalo

H. P. Eddy Reports on Bids Advising Against Incineration and Recommending Either (1) Reduction or (2) Hog Feeding with Residue Driers of One-Half Piggery Capacity

BASED UPON a detailed analysis and comparison of bids for various single and combined processes of garbage disposal obtained last year by the city of Buffalo but not yet acted upon, Metcalf & Eddy, consulting engineers, Boston, Mass., have advised against incineration, either singly or to treat piggery wastes, and have recommended that a choice be made between garbage-reduction by the Cobwell-Merz process and a piggery supplemented by a garbage-and-manure drying plant.

Bids Were On Open Specifications—The bids considered were based on the bidder's own plans for plant and machinery only and could not be compared for purposes of the report until after elaborate estimates had been made to cover various omitted items necessary for working installations. After this had been done, and the schemes offered had been reduced to two, it was found that there was but little difference in capital cost between reduction alone and a piggery combined with a plant to dry the uneaten garbage and the piggery manure, but that the cost per ton for reducing 40,000 tons of green garbage a year would be some 40 per cent more than for feeding the same amount of garbage to hogs and disposing of the residue and the hog manure by drying. Reduction would yield grease and fertilizer base. The other plan would produce fat hogs and fertilizer base. It should be understood that of the three types of incinerators formally bid on only one had ever been operated in this country, and that on a small scale; none, the report states, had been used for garbage unmixed with combustible waste; and none had ever consumed garbage-feeding wastes. The final recommendation of the report was that the city authorities decide between (1) reduction alone and (2) hog feeding and residue drying and then have a plant of the type chosen properly designed and invite bids on the city's designs.

The bids in question were received July 25, 1922, and transmitted to the Buffalo Commission Council on Oct. 18, 1922, by William F. Schwartz, street commissioner of Buffalo, with a request that he be authorized to engage H. P. Eddy, of Metcalf & Eddy, to report on the bids. On Oct. 25, Mr. Eddy was authorized to make such a report, which was sent to Mr. Schwartz on March 10, 1923. The latter transmitted the report to the City Commission April 18, with the request that the Commission choose one of Mr. Eddy's alternative plans, Mr. Schwartz himself recommending the combined piggery and residue-drying plant as the least expensive of the two. The Buffalo Council has not yet acted on the recommendation.

Reduction Formerly Used at Buffalo—For many years the garbage of Buffalo was disposed of by reduction under various contracts. The latest of these was with the International Agricultural Corp., known locally as the Buffalo Fertilizer Co., at a plant located at Sloan, N. Y. On renewal of a contract with this company that expired July 31, 1916, the contract price was reduced from $1.25 to $1 per ton, and after the renewed contract expired three years later the same concern continued to dispose of the garbage until Oct. 1, 1919, but on a cost plus 10 per cent basis. During these two months the city delivered 3,714 tons of garbage to the company and paid it $13,515 or $3.64 a ton for its services, the amount being certified to by public accountants.

Change to Hog Feeding—Meanwhile a five-year contract was let for disposal by feeding to hogs, the price paid to the city to be 50c. a ton of garbage delivered to the contractor as a minimum, with maximum prices per ton 6, 7 and 8 times the price of live hogs, as the quantities of garbage increased. This contract was let to Dr. T. B. Huff, who organized the Huff Feeding Corp. This company, Mr. Schwartz states in his letter transmitting Mr. Eddy's report to the Buffalo Council, leased a site on the river road and spent $247,000 for hogs, buildings, water and sewer pipes. Mr. Schwartz adds that the company never had hogs enough to dispose of the garbage; that its sewage-works were inadequate; that large quantities of garbage remained uneaten, and that this material, together with hog offal, dumped on fields around the piggery, caused bad odors, swarms of flies, and a nuisance that led to local complaints and then to orders from the State Department of Health to abate the nuisance.

City Took Over Piggery—The outcome of the conditions just outlined was that the city took over the plant on Oct. 2, 1921, subsequently paying $45,000 for liens and claims against the Huff Feeding Corp. and $72,157 to the owner of 2,810 hogs at the piggery. From Oct. 1, 1919, to April 1, 1922, Mr. Schwartz states, about 100,000 tons of garbage were disposed of at the piggery, at a profit of about $15,000 to the city (methods of figuring profit not stated).

Bids Invited and Received—The lease of the piggery site, which expires Oct. 1, 1924, was such that the city did not feel warranted in spending money to improve the plant. Accordingly, Mr. Schwartz was authorized by the council to advertise for bids for (1) garbage disposal sites; (2) "machinery and equipment" to dispose of 200 tons of garbage daily by either incineration or reduction; (3) "machinery and equipment" as in (2) but of a capacity of 50 tons or more daily, to handle uneaten garbage, etc, and manure from a piggery, the latter to be provided by the city. Under (2) and (3) the bidders were to submit "detailed plans and specifications showing their methods of incineration or reduction, * * * * the cost of operation per ton, the commercial value of the residue, the names of the cities where similar plants are being operated, and a guaranty that no obnoxious gases or odors will be created through operation." The site specifications called for land within 15 miles of Buffalo, adjoining a railroad, the areas to be not less than ten acres for either an incineration or a reduction plant and from 200 to 600 acres for a piggery combined with a smaller reduction or incineration plant.

Four Proposals Found Informal—Four of the nine proposals were thrown out by Mr. Eddy as not complying with the city's specifications. Of the five remaining bidders, three proposed incineration, one drying to pro-

duce fertilizer material, and one reduction—for grease and fertilizer. Although Mr. Eddy worked out comparative costs for each of the five bidders and their ten bids yet in his conclusions he advises against incineration for Buffalo garbage, for reasons stated below. He also strongly recommends that the city decide whether it wants a reduction plant alone or one to dispose of the residue from a piggery and then have complete designs made for the kind of plant chosen and invite bids accordingly.

Five Bids Considered—The five bids studied by Mr. Eddy may be summarized as follows, taking the three bids for incinerators first, then the one for drying and finally that for reduction:

Vulcan Incinerator Co.—Top hand-fed incinerating units, circular in plan, about 12 ft. in diameter, with a two-story firebox projecting at the front so as to give a fire above and below the garbage; and a combustion chamber and dust collector projecting at the rear. Forced draft is provided for the extra grates and for the incinerating chamber, forced-draft air to be preheated. No power production from waste heat is proposed. There is no mechanical apparatus for handling either the garbage, clinker, ashes or dust. The total operating cost of properly operating a 200-ton-per-day plant is given in the bid as not above an average of $1 per ton of garbage incinerated. Vulcan incinerators are reported as in operation at Ardmore, Durand and Okmulgee, Okla., these places having had populations of 7,340, 14,187 and 17,430 in 1920.

Balmer Corp.—Top hand-fed units of three furnaces, with induced and forced draft of preheated air, the hot gases passing around baffle walls in a gas-settling and combustion chamber. Clinker and ash are lifted by elevators to elevated storage bins for removal by trucks. No power production from waste heat is proposed. Balmer plants are reported in operation with capacities from 5 to 1,000 tons in 24 hr.; one of 1,000-ton total capacity in Buenos Aires, a 300-ton plant at Montevideo and a dozen smaller ones in the Argentine.

George W. Goethals & Co., Inc.—A "universal incinerator, Didier system" is proposed in which the garbage is shredded, stored in bins, fed to charging cans and incinerated in retorts under preheated force draft. The gases from each battery of retorts pass through a portion of a combustion and settling chamber, the upper part of a water-tube boiler and a boiler superheater, the lower part of the water-tube boiler, and thence through the second compartment of the combustion chamber, in which there is a heater for the air blast. Two Didier plants have been operated: a 50-ton plant at Davos, Switzerland, a place of 15,000 population; and a 100-ton plant for Weisbaden, Germany. The smaller plant is in use but the larger one was shut down in 1919 on account of lack of funds.

C. H. A. Wannenwetsch & Co.—This bid is for converting garbage to a fertilizer base, by grinding, wringing or pressing, and drying after pre-sorting out foreign material by hand on a belt, with salvage of rags and other salable substances, and after pieces of iron and steel have been removed by passing the sorted garbage through magnetic rolls. The dryers are vertical steam-jacketed cylinders provided with stirring paddles on a vertical shaft. Plants of this kind "have been and are now operated" at industrial works to dry animal tankage, and "in one case piggery refuse was successfully dried under our observation." The report also states that such a plant is now being used to dry "garbage at the Buffalo Municipal Hospital."

C. O. Bartlett & Snow Co.—The "Cobwell-Merz process" for recovery of grease and tankage was proposed, making use of disintegrators, dehydrators, reducers (heat and solvent), with screens and magnetic separators for dried tankage and multiwhirl condensers, coolers and separators for grease. Besides installation cost a 6 per cent royalty fee on gross income from products during the remaining life of the patent (granted in 1918) would be paid by city. The process, at the time of the bid, was in use in New Bedford, Mass., Rochester, and Syracuse, N. Y., and had been used at Los Angeles, Calif. [and for a short time in New York City.—EDITOR].

Amount of Garbage—During the year ending with September, 1922, the deliveries of garbage to the piggery totalled 20,762 tons. It is estimated that this came from only 60 per cent of the population so that with complete collection there would have been 34,600 tons for disposal, or an average of 95 tons a day for every day in the year, or 115 tons per collection day (300 such days in a year). Based on the maximum collection day (112.8 tons) the daily maximum with full collection would be 188 tons. In percentages of average collection day the figures are: Maximum day, 169; maximum week, 150; maximum five consecutive weeks, 131.

The per capita production for the year 1921-22 [(Collection ÷ 60) × 100] was 132 lb. Mr. Eddy assumes for 1923 an average production of 150 lb. per capita for a population of 533,000, which would give 40,000 tons for the year and average 133⅓ tons per collection day. Adding 50 per cent the maximum collection day would give 200 tons—which was the basis for the bids.

Meager Data; Bids Not Comparable—The meagerness of the information as to the "character and sufficiency of the mechanical devices" proposed by the bidders and the fact that the bids are "not strictly comparable" because of the differences in design of the plants proposed made it necessary for Mr. Eddy to estimate the cost of various plants complete, together with their operating expense and revenues, annual charges and net annual costs in order to make the bids comparable; also to make estimates for 100-ton plants in place of the 50-ton plant bids, since Mr. Eddy concluded that to dispose of piggery wastes 100-ton plants would be required.

Tabular Data—Table I herewith, which is a combination of several tables and parts of tables in Mr. Eddy's report, reduces to a comparative basis the bids for the 200-ton plants for disposing of all the garbage, and the bids for the 50-ton plants for piggery wastes only (compared as to first cost only, since Mr. Eddy considers a 50-ton plant for this work only half large enough). Table I also gives a summary of the comparative estimates for 100-ton plants to handle piggery wastes only.

Incinerator Bids Dropped—After considering these figures and related matters Mr. Eddy dropped from further consideration the three incinerator bids. His reasons for doing this are:

> Conclusions: Incineration of garbage containing about 75 per cent moisture without the addition of fuel and without creating offensive odors with any of the incinerators bid upon appears to us to be impracticable.

TABLE I—COMPARISON OF BIDS FOR VARIOUS METHODS OF DISPOSAL OF THE GARBAGE OF BUFFALO

Construction Cost: 200-Ton Plant (Excluding Land)

	Vulcan Incinerator Co.	Balmer Corp.	George W. Goethals Corp.	C. H. A. Wannenwetsch & Co.	C. O. Bartlett & Snow Co.
Proposal price	*$90,700*	*$300,000*	*$309,400*	*$218,000*	*$292,000*
Metcalf & Eddy estimate of items not covered by proposal[1]	197,200	64,400	269,000	273,700	283,400
Total	$287,900	$364,400	$578,400	$491,700	$575,400
Add for omissions 5 per cent	14,400	18,200	28,900	24,600	28,800
Total	$302,300	$382,600	$607,300	$516,300	$604,200
Add for engineering and contingencies 15 per cent	45,300	57,400	91,100	77,400	90,600
Total (revised estimate)	**$347,600**	**$440,000**	**$698,400**	**$593,700**	**$694,800**
Total, per ton of capacity	$1,738	$2,200	$3,492	$2,969	$3,474

Annual Operating Cost and Returns: 200-Ton Plant—133⅓ Tons per Day, 300 Days per Year—40,000 Tons per Year.

Supervision and labor (8-hr. day)	$35,600	$34,400	$39,900	$71,100	$78,000
Fuel, coal at $5.50 per ton	17,600	17,600	17,600	26,400	55,000
Solvent at $0.16 per gal., 3 gal per ton	.....	.....	.....	.....	19,200
Water supply at 150 per cent of city rates	400	400	2,800	17,200	400
Light at $0.10 per kw.-hr.	2,100	1,100	.....	3,800	.....
Power at $0.01 per kw.-hr.	2,000	2,000	.....	10,000	.....
Miscellaneous supplies and expense at $0.15 per ton	6,000	6,000	6,000	6,000	7,500[2]
Repairs and maintenance	4,100	6,500	11,900	6,000	9,200
Royalty at 6 per cent of income, equal $0.28 per ton	.....	.....	.....	.....	11,200
Estimated gross annual cost of operation	$67,800	$68,000	$78,200	$140,500	$180,500
Return from sale of products—					
Tankage	.....	.....	.....	41,000	63,000
Grease	.....	.....	.....	.....	120,000
Miscellaneous residuals at $0.10 per ton	.....	.....	.....	4,000	4,000
Estimated total return	.....	.....	.....	45,000	187,000
Estimated net annual cost of operation	$67,800	$68,000	$78,200	$95,500	$6,500
Cost of operation per ton (40,000 tons)	$1.69	$1.70	$1.96	$2.39	$0.16[3]

Annual Fixed Charges: 200-Ton Plant

Interest at 4½ per cent	$15,600	$19,800	$31,400	$26,700	$31,300
Depreciation[4]	9,900	13,000	26,700	21,900	32,100
Total estimated annual fixed charges	$25,500	$32,800	$58,100	$48,600	$63,400
Fixed charges per ton (40,000 tons per year)	$0.64	$0.82	$1.45	$1.21	$1.58

Grand Summary: 200-Ton Plant, Total Net Charges

Estimated total net annual operating cost and fixed charges	$93,300	$100,800	$136,300	$144,100	$56,900
Total net operating cost and fixed charges per ton (40,000 tons per year)	$2.33	$2.52	$3.41	$3.60	$1.42

50-Ton Plant, Construction Cost:

Proposal price	*$31,300*	*$80,000*	*$115,000*	*$78,000*	*$197,700*
Metcalf & Eddy estimate of items not covered by proposal	104,700	58,000	146,200	141,900	170,300
Total	$139,000	$138,000	$261,200	$219,900	$368,000
Add for omissions 5 per cent	7,000	6,900	13,100	11,000	18,400
Total	$146,000	$144,900	$274,300	$230,900	$386,400
Add for engineering and contingencies 15 per cent	21,900	21,700	41,100	34,600	58,000
Total (revised estimate)	**$167,900**	**$166,600**	**$315,400**	**$265,500**	**$444,400**

100-Ton Plant: Construction, Operation, Fixed and Total Annual Charges, 66⅔ Tons per Day—300 Days per Year—20,000 Tons per Year[5]

Estimated total cost of construction (excluding land)	$236,700	$259,600	$443,200	$376,700	$724,200
Cost of construction per ton of capacity	2,367	2,596	4,432	3,767	7,242
Estimated net annual operating cost	51,650	48,300	57,200	69,700	41,700
Operating cost per ton (20,000 tons per year)	2.58	2.41	2.86	3.49	2.09
Annual fixed charges	16,950	19,150	36,300	30,450	68,050
Estimated total net annual operating cost and fixed charges	68,600	67,450	93,500	100,150	109,750
Total net operating cost and fixed charges per ton refuse (20,000 tons per year)	3.43	3.37	4.68	5.01	5.49[6]
Total net operating cost and fixed charges per ton garbage (40,000 tons per year)	1.72	1.69	2.34	2.51	2.75[6]

[1] The items estimated to supplement the prices contained in the proposals include, where required, ramps, buildings or enlargements of buildings, garbage storage bins, employees' rooms and lockers, coal storage bins, office and weighhouse, ash storage bins, ventilating equipment, garbage and ash-handling equipment, railway siding, track and wagon scales, grading, pavements and planting, water supply, sewerage, drainage and sewage disposal facilities. No allowance has been made for unusual or difficult foundation work.

[2] Includes ½ lb. chlorine per ton of garbage at 7½c. per lb. chlorine.

[3] Profit.

[4] Depreciation allowances varied to suit character of plant but all figured on sinking fund basis, with contributions added and 4 per cent compound interest credited at end of each year.

[5] The 100-ton plants would treat piggery residue (uneaten garbage, etc., and manure). No piggery costs or revenues are included here, because Mr. Eddy does not recommend incineration for the piggery residue, but confines his combined piggery and piggery-waste disposal estimates to the Wannenwetsch and Cobwell bids for drying and reduction, respectively, as shown in Table II. See also footnotes to Table II for basis of estimating tankage and grease values.

TABLE II—ESTIMATE COST OF GARBAGE DISPOSAL BY PIGGERY WITH DRYING OR WITH REDUCTION FOR RESIDUE

Based on 200-ton piggery and 100-ton residue disposal plants—133⅓ tons of garbage per collection day—40,000 tons of garbage per year—20,000 tons of piggery residue per year.

	Piggery With Wannenwetsch Drying Plant	Piggery With Cobwell Reduction Plant
Construction Cost		
Cost of building piggery (6,000 head)	$301,000[1]	$301,000[1]
Cost of building refuse disposal plant	376,700	724,200
Total construction cost	$677,700	$1,025,200
Operation Cost		
Annual excess of return over cost of operating piggery	$79,600[2]	$79,600[2]
Net annual cost of operating disposal plant	69,700	41,700
Balance—Difference between annual excess return over operating cost for piggery and operating cost of disposal plant (profit)	9,900	37,900
Annual Charges		
Annual balance of receipts and expenditures for piggery and disposal plant (profit)	9,900	37,900
Fixed charges on piggery	20,700	20,700
Fixed charges on disposal plant	$30,450	$68,050
Total fixed charges	51,150	88,750
Net annual charges	41,250	50,850
Net annual charges per ton of green garbage, 133⅓ tons per collection day, 40,000 tons per year	1.03	1.27[3]

[1] The main items are: Hog houses, $212,000; miscellaneous buildings, heating and equipment, $27,000; engineering omissions and contingencies (15 per cent on $262,000) $39,000.

[2] The annual charges total $91,800. Of this $71,000 is for operating expenses, thus divided: Supervision and labor, $33,700; freight, $19,000; light, power and water, $800; repairs and maintenance. (1 per cent on $301,000.) $3,010; carting, $1,600; supplies and miscellaneous, $13,000. The $20,700 fixed charges on the $301,000 of the capital cost include $13,500 for interest and $7,200 for depreciation, interest being figured at 4½ per cent and sinking fund at 2.4 per cent (25-year. Life), with 4 per cent on accumulated amounts. The net profit is based on a purchase of 19,500 hogs weighing 125 lb. each, a death rate loss of 5 per cent and a total sale of 18,500 hogs weighing 200 lb. each, the total weight bought being 2,437,000 lb., at 9c. a pound, costing $219,300 and the total weight sold being 3,700,000 lb. at 10c. yielding $370,000. This gives $150,700 for net gain in weight. Deducting from this $91,800 gives $58,900 as the net profit on the piggery or $1.47 per ton of garbage delivered. The average cost of hogs bought for the existing Buffalo piggery during the 13 months ending Oct. 31, 1922, was 10.8c. per pound (but not including freight) and the selling price averaged 11.9c., making a gross gain of 1.1c. per pound, with no allowance for freight or death losses. Hogs from the Buffalo piggery, Mr. Eddy states, command a price above the general market price because of the certainty that all of the piggery hogs have received double inoculation.

[3] The higher net annual cost per ton for the Cobwell than for the Wannenwetsch plant when each handles 100 tons of piggery refuse than when each treats 200 tons of green garbage, Mr. Eddy states, is due to the fact that in the 100-ton Cobwell plant the pre-drying in direct-heat driers is omitted, whereas in the 200-ton plant these driers are provided; this omission, Mr. Eddy states, makes necessary the installation of extra Cobwell reducers, which increase the cost figures as indicated. It is assumed that the unit yield and prices of grease and tankage will be the same from the green garbage and from the combined garbage and manure from the piggery. Two samples of piggery refuse, collected March 15, 1922, and Feb. 1, 1923 (the latter by a representative of Metcalf & Eddy), showed the following percentages after having been dried in a Wannenwetsch reducer in use at a local packing house for rendering animal tankage: Grease, 12.33 and 16.34; ammonia, 3.14 and 3.01; boné phosphate of lime 2.28 and 8.39; potash (K_2O) 1.15 and 1; moisture, 7.07 and 7.69.

TABLE III—COMPARISON OF MOST ADVANTAGEOUS PROJECTS FOR (1) DIRECT DISPOSAL AND FOR (2) PIGGERY WITH AUXILIARY DISPOSAL

Each plant has a daily capacity of 200 tons of green garbage and is to dispose of 40,000 tons a year. The Cobwell reduction plant would treat all the garbage, and recover fertilizer base and grease. In the combination plant all the garbage would be offered to the pigs and the uneaten material and pig manure (assumed as 100 tons per collection day, and 20,000 tons per year) would be passed through the Wannenwetsch drying plant for the recovery of fertilizer base only.

	C. O. Bartlett & Snow Plant (Cobwell Reduction Process)	Piggery Combined With C. H. A. Wannenwetsch Drying Plant
Construction cost	$694,800	$677,700
Net annual operating cost per ton (profit)	0.16	0.25
Total net annual charges per ton	1.42	1.03

To add fuel to garbage economically would require constant regulation according to the proportion of moisture contained in the garbage.

The control of fuel in this manner would require very close attention to operation and it is probable that lapses in control would occur and that offensive odors would escape during such times.

The only way in which fuel could be provided within the limits of the specifications of the bidders would be to add rubbish or coal with the garbage as fed into the incinerators. Control would depend upon the judgment of the men mixing the garbage and fuel. It is probable that offensive odors would be produced at times, and that fuel would be wasted at other times.

The estimates of cost indicate that disposal by any of the incinerators bid upon will be more expensive than that by another method.

None of the incinerators bid upon has been operated in this country on anything but a very small scale, if at all, and such operation as has been cited by the bidders appears to have been upon refuse and not upon garbage alone.

In view of these conditions we are of the opinion that none of the bids for incinerators constitutes the most advantageous bid, considering not only the cost of installation and operation but also the sanitary disposal of the garbage and freedom from odor in operation.

Because of the nature of the material the disposal of piggery refuse by incineration will be more difficult and more likely to create offensive odors than the disposal of green garbage by this method. For this reason plants combining a piggery and an incineration plant have not been included herein.

We are of the opinion that the installation of any of the incinerators bid upon is not justified for the disposal of so large a quantity of garbage as that produced at Buffalo.

Comparison of Combined Piggery and Residue Disposal Plants—Table II summarizes Mr. Eddy's comparative estimates of net annual charges on a combined plant in which 200 tons of garbage would be: (1) fed to pigs and the uneaten material and pig manure reduced in 100-ton plants of the Wannenwetsch drying type to produce fertilizer base, and (2) the entire 200 tons of green garbage would be treated in a reduction plant of the Bartlett & Snow or Cobwell type, yielding both fertilizer base and grease. The first cost of the combined piggery and drying plant would be $677,700 and of the piggery and reduction plant, $1,025,200, but taking all charges into account the net tonnage cost would be $1.03 against $1.27. The Cobwell combination is at a disadvantage here since it is based on the 50-ton Cobwell bid in which extra reducers were required because the preliminary driers included in the 200-ton Cobwell bid were omitted.

Final Comparison—Mr. Eddy compares (Table III) the most advantageous of the projects for treating the entire 200 tons of garbage with the most advantageous combined piggery-and-residue treatment plan; or a 200-ton Cobwell reduction plant using pre-driers and producing grease and fertilizer base and a 200-ton piggery and a 100-ton drying plant to produce (a) fat hogs and (b) fertilizer base, from the uneaten garbage and hog manure. This comparison shows first costs close together, $694,800 for (1) against $677,700 for (2), but net charges of $1.42 and $1.03 respectively.

Mr. Eddy expresses the belief that a piggery can be successfully built and operated in a sanitary way and that either the Cobwell or Wannenwetsch process can be operated without odor. He considers the value of the dried garbage from the Wannenwetsch process as "problematic" because its large fat content would probably lessen its value as a fertilizer base, but allowance was made for this in the estimates. He points out that more operating skill is required for the Cobwell-Merz reduction process (as he calls the plant on which 200-ton bid was based) than for the Wannenwetsch drying process.

He points out that there are hazards, whichever of the two plans are chosen—of explosion in a reduction plant using solvent and of foot-and-mouth disease in the piggery. In case of the latter contingency, however, the supplementary drying plant would take care of half the garbage while, if the reduction plant were destroyed the entire volume would be subject to emergency disposal. Also, should a combination piggery and drying plant be built and the piggery subsequently abandoned, the drying plant would be available up to its capacity. Mr. Eddy also suggests that it "may be feasible, should circumstances justify it, to equip" the piggery-refuse drying plant for grease recovery.

Such objectionable odors as have occurred at garbage piggeries Mr. Eddy attributes to the piggery refuse, "which often has not been promptly and thoroughly cleaned up, and generally has not been disposed of in such a manner as to prevent offensive odors." Adequate provision for the prompt and sanitary disposal of piggery refuse "would be an important forward step" in garbage disposal by feeding to hogs. Either the Cobwell-Merz process for all the garbage or a combination piggery and Wannenwetsch residue drying plant "can be so constructed and operated," the report states, "as not to produce objectionable conditions in the neighborhood," *but* this "is dependent in both cases on skilled management."

Size and Cost of Plants Required in 1935—By 1935 it may be expected that the population of Buffalo will have increased to 640,000 (from about 500,000 in 1920). This would require a 240-ton plant, the approximate cost of which would be $775,000 for a Cobwell-Merz green garbage plant and $779,000 for a piggery combined with a Wannenwetsch auxiliary drying plant.

What Buffalo Should Do—Having shown that either of the alternative schemes selected from those bid on as most advantageous would require almost the same capital outlay, but would differ, as outlined, in gross and net operating costs and in total net annual charges, and in respect of risks, Mr. Eddy leaves the final choice to the city of Buffalo, but he adds this unequivocal advice: (1) The city should decide on one or the other scheme, then have complete designs made and request bids for its construction, and (2) the city should not overlook the fact, as has so often been done, that efficient operation is as essential as correct design and construction, for [italics ours—EDITOR], *"The primary object of the operation of such a plant should be the disposal of the garbage in a sanitary manner. The accomplishment of this object at the smallest expense, although of great importance, is an aim of secondary moment.*

[Information from Mr. Schwartz, sent Sept. 13, indicates that a site has not yet been obtained owing to strenuous objections to every site proposed; also that the city is under a court order to close the piggery on Sept. 15 but has secured a hearing for Sept. 26 on a petition for a modification of the order to give the city time to find some other means of disposal, and had also filed an appeal from the order.—EDITOR.]

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

A Guide to City Planning and Zoning

MANUAL OF INFORMATION ON CITY PLANNING AND ZONING: Including References on Regional, Rural and National Planning—By Theodora Kimball, Librarian, School of Landscape Architecture, Harvard University; Honorary Librarian, American City Planning Institute; Associate, British Town Planning Institute. Cambridge: Harvard University Press. London: Humphrey Milford; Oxford University Press. $3.50.

Rarely does a new art or science have so devoted and competent a guide to sources of information as Miss Kimball has been for some years past. Her present volume surpasses her earlier reference works in variety and extent. The result is worthily called a Manual of Information.

Miss Kimball has obtained contributions from Flavell Shurtleff, secretary of the National Conference on City Planning, and from John M. Gries, chief of the Division of Building and Housing, U. S. Department of Commerce, on the work being done by those two agencies. There is also a note from Stephen Child on L'Union Internationale des Villes and the American Center of Civic Documentation, two ambitious projects as yet in their infancy. Other information given relates to various government and private agencies devoted to city planning; periodicals treating the subject; colleges and universities having courses in city planning; educational films; typical city planning reports, by years; and a table of municipal appropriations for city planning work, covering the past few years. The larger part of the book is filled with a Bibliography. This contains many hundred references to books and periodicals, classified and sub-classified in detail. The arrangement is numerical but there is a classified contents and an alphabetically arranged subject index.

Enough has been said to make clear that the Manual is a valuable guide that no practitioner or student of city planning or zoning should be without.

For Every Engineer

ESTIMATING BUILDING COSTS—By Charles F. Dingman, M. Am. Soc. C. E., M. Am. Soc. M. E., M. N. J. Soc. A. New York and London: McGraw-Hill Book Co. Flexible cloth; 4x7 in.; pp. 240. $2.50.

In its small compass of 240 pages this manual contains more direct instruction on how to estimate costs than any other book known to the reviewer. There are more comprehensive volumes of data which are useful for estimating. The author gives a list of these books and urges all estimators to become familiar with them. While not lacking in essential data, his own volume is primarily a handbook of estimating processes. He undertakes to guide the reader through all the moves of estimating the cost of each operation of building work. Beginning with excavation, instruction is given, in separate chapters, on how to estimate brickwork, stone work, fireproofing, concrete, timber-framing, covering, finishing, roofing, plastering, and painting. There are general chapters on short-cut methods and on such estimating aids as remainder lists and equipment-rental tables. Plumbing, heating, electrical wiring and mechanical equipment are not considered, the author advising that sub-bids be secured from specialists in these operations. For the beginner in problems of estimating, no better book of instructions is known. Even the experienced estimator will find it an aid in securing orderly thinking and practices. One could wish that every engineer would read it to the purpose at least of absorbing the fact that true estimating is one of the most complex problems of construction engineering.

Acoustics and Soundproofing

REVIEWED BY E. A. ECKHARDT
Physicist, Bureau of Standards, Washington, D. C.

ACOUSTICS OF BUILDINGS: Including Acoustics of Auditoriums and Soundproofing of Rooms—By F. R. Watson, Professor of Experimental Physics, University of Illinois. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 155; 72 line cuts and halftones. $3.

Most engineers and architects engaged in designing buildings have experienced the embarrassments presented by the acoustic problems encountered. These problems in their major aspects involve either the insulation of one part of a building from another so that the use of each may be enjoyed without interference from the other or the arrangement of a room or auditorium so that satisfactory hearing conditions may prevail within it. Within a period of two years two books covering this ground have appeared in the English language, both in America. Professor Wallace C. Sabine's "Collected Papers on Acoustics" was the first to appear. It includes reprints of the various papers published by the author during the progress of his pioneer work in the subject. The value of this collection is beyond question. From the point of view of the user, however, it is unfortunate that the material was not reworked into a systematic unit. Prof. F. R. Watson's new book "Acoustics of Buildings" gives a systematic presentation of the subject designed to facilitate the direct application of the information conveyed. It should therefore have great practical usefulness.

Prof. Watson has made very substantial contributions to the subject matter of his book and it is therefore quite natural that a large part of the reading matter is a recapitulation of his earlier publications. This has been done, however, without impairing the systematic character of the presentation. The book is divided into three parts dealing with the fundamental physical ideas involved, their application to the acoustics of auditoriums and the soundproofing of buildings respectively. The large number of practical examples taken from the author's wide experience gives concreteness to the abstract principles presented and makes it easier for the reader to make similar applications to problems of his own.

On one important question involved in the acoustics of rooms Prof. Watson is undoubtedly in error. He concludes that the acceptable time of reverberation for auditoriums for different volumes varies with the cube root of the volume. In auditoriums the problem is almost invariably to get the reverberation time small

enough, and in very large auditoriums the cost usually determines how closely the ideal may be approached. Prof. Sabine found a definite reverberation time to be the ideal, independent of the size of the room, but somewhat different for speech and for music. Departures from these ideal values are compromises made to meet some other requirements, usually to stay within the limits set by the purse. As a matter of compromise, large auditoriums will have larger reverberation times, but if no expense is spared in further reducing the reverberation time, improvement will certainly result.

Prof. Watson's book is well illustrated by photographs, diagrams and graphs, and as the first comprehensive systematic presentation in the English language will be welcomed by those seeking information on the questions of "Building Acoustics."

Timely and of World-Wide Moment

GERMANY'S CAPACITY TO PAY: A Study of the Reparation Problem—By Harold G. Moulton and Constantine E. McGuire, with the Aid of the Council and Staff of the Institute of Economics. New York and London: McGraw-Hill Book Co. Cloth; 5x8 in.; pp. 384; 7 line cuts. $2.50.

Timeliness and an able marshalling of facts and figures are shown in this readable discussion of the greatest question now confronting the world, Germany's capacity to pay war reparations. The last touches were given to the book in June so that, except for the recent spectacular further decline of the mark, the implications of the fall of the Cuno cabinet and the latest stages of the Franco-British notes, the book is up to the minute.

The authors make no attempt to name a sum which Germany can pay. The entire discussion is on her capacity to pay as indicated by reviews of what is involved in paying foreign debts, the German international trade balance for decades past (nearly always adverse), what Germany has already paid, foreign trade requirements, the German budget and monetary problems, a significant chapter on How France Met the Indemnity of 1871 (by loans, on which large interest payments are still being made) and the international phases of the reparations problems. There are seven appendices of supporting data, well designed to keep the main text free from burdensome statistics.

The two concluding sentences of the book sum up its spirit and the substance of such conclusions as are reached:

> If one believes that the economic prosperity of the world will be promoted by the economic recovery and the restoration of the consuming power of Germany, he should favor her importation of large quantities of necessary food and raw materials and the exportation of correspondingly large quantities of manufactured goods. If, on the other hand, one believes that the disintegration of the German industrial system and the starvation of some millions of German people will promote the general welfare of the world, then he should welcome the continued curtailment of both German import and export trade.

Since the economic, social and political welfare of the world hinges so largely on the solution of this great German problem and any right and fairly prompt solution depends so much upon a sound public opinion, the book deserves wide reading. Certainly no one is qualified to pass judgment on Germany, France, England and the other countries involved without having in mind the major facts and principles which this book sets forth.

British House Sanitation

DOMESTIC SANITATION AND HOUSE DRAINAGE—By Henry C. Adams, M. Inst. C. E., F. R. San. I., M. Inst. Water Eng., Consulting Engineer; Lecturer on Sanitary Science, Northern Polytechnic. [Oxford Technical Publications.] London: Henry Frowde and Hodder & Stoughton. New York: Oxford University Press, American Branch. Cloth; 6x9 in.; pp. 227; 193 line cuts and halftones. $3.50.

British practice in house-design and construction as regards site, subsoil drainage, safeguards against dampness, the entire range of plumbing, earth privies and pail closets, refuse disposal, lighting, warming and ventilation are reviewed in this volume. School sanitation has a chapter but it is devoted wholly to water closets and urinals. There are short chapters on stables and cowsheds and a few pages on sanitary surveys.

The book is almost free from even late-Victorian notions on such matters as "sewer gas" and disease but contains these sentences, which might have been written when Victoria ascended the throne:

> The close relation between malaria and the soil is shown in various ways. If the sun's rays are prevented from reaching the soil by the interposition of paving, malaria ceases. If a marsh be flooded from the sea and a layer of salt water covers the soil, malaria disappears. It is promoted by the rapid drying up of marshes and river beds, and is especially rife when such soil is broken up and fresh surfaces are exposed to the sun. Subsoil water or dampness is an essential condition of malaria, and is especially harmful if the subsoil water is stagnant. For this reason villages are built on hills, but the wind may carry the malarial poison long distances.

The only reference to mosquitoes found in the book is a single sentence which the author, after declaring that the "neighborhood of marshes is bad for dwellings" because of various gases given off by marshes, adds: "They (marshes) also cause an excess of aqueous vapor and form breeding-grounds for mosquitoes." Why mosquitoes are objectionable the author does not state.

Either the author can never have heard that malaria is spread not by "bad air" from whatever source, but by mosquitoes that breed in marsh and other stagnant waters, or else he is willing to accept what all sanitary entomologists and—in this country at least—sanitary engineers also have accepted for some two decades. This blemish on the book is all the more a pity because the volume is based on lectures to "students" (of what sort is not stated) who presumably take as sanitary law and gospel all that a member of the Institution of Civil Engineers says.

PUBLICATIONS RECEIVED

THOSE WHO WISH to get some of the latest ideas on the civil service as applied to cities will do well to get the August *National Municipal Review*, which is devoted wholly to a report of the National Municipal League's Special Committee on Civil Service, and supporting and opposing written discussions. The title of the report is "Employment Management in Municipal Service." Among the members of the committee are Henry S. Dennison, president, Dennison Manufacturing Co., chairman, and William C. Beyer and Morris B. Lambie, of the Philadelphia and the Minnesota Bureaus of Municipal Research. Fourteen persons contribute discussions, including Col. H. M. Waite, formerly city engineer of Cincinnati and (later) city manager of Dayton, Ohio; C. R. Woodruff, president and C. S. Shaughnessy, chief examiner, Philadelphia Civil Service Commission; and W. D. Foulke, president, National Civil Service Reform League. (National Municipal League, 261 Broadway, New York City; 50c.)

THE LIST OF ENGINEERING ARTICLES on irrigation and related subjects published from time to time by the U. S. Reclamation Service fills 31 pp. of the latest report of the Service, and, together with a list of books of 2 pp., has been printed in pamphlet form (Washington, D. C.). The articles are grouped into general and those relating to some one of the many projects and are further classified by authors. There are about 360 references to *Engineering News-Record*, *Engineering News*, and *Engineering Record*, of which 110 are general and 250 deal with a single project. Of the 28 projects, only one shows no reference to this journal or its two forerunners and for that project there are only two references. Under the Boise Project (Idaho, Arrowrock dam, etc.) there are 34 references to one of the three journals named above; under the Rio Grande Project (New Mexico-Texas, Elephant Butte dam, etc.) there are 25 references.

THE DIESEL OIL ENGINE FOR WATER-WORKS SERVICE, a paper by Dr. Charles E. Lücke, together with related papers and discussions, have been reprinted from the *Journal* of the N.E.W.W. Assoc. for June and may be obtained from the Worthington Pump & Machinery Corp., 115 Broadway, New York City.

NORTHWEST LUMBER AND ALLIED INDUSTRIES are listed in *Abbey's Register* which covers Arizona, Idaho, Montana, Nevada, Oregon, Washington, Alaska, and British Columbia. Logging operations, saw, planing and shingle mills, box, sash and door and other manufactures are included, besides wholesalers and brokers. (Portland, Ore.: The Industrial Service Co. Cloth; 6 x 8 in.; pp. 312.)

Foreign Papers and Reports

EIGHT ANNAS is the price of "Notes on the Identification of Timbers in Southern India," by R. B. Robinson, engineer, South India Railway, Simla, India. Among the plates are a number of enlarged colored transverse sections of various timbers.

A NOTABLE DISCUSSION of "Rainfall and Runoff" by R. W. Holmes, of Auckland, New Zealand, has reached this country in the form of a reprint of a paper read by Mr. Holmes before the New Zealand Society of Civil Engineers. Long-time precipitation records at Auckland, N. Z., Norfolk, Va., Hemel Hempstead, England, Padua, Italy, and Rockhampton, Australia, are presented graphically by years in terms of percentages of the average for the period for each of the stations named. Other diagrams show deviations from the averages for groups of consecutive years in percentages of the average. Mass rainfall curves are also presented. Some interesting diagrams illustrate a brief study of tree-growth rings in relation to rainfall. The text discusses all these matters and some runoff data as well.

LIKE MANY OTHER CITIES, Glasgow, Scotland, is studying the activated-sludge process. Tests were made in 1915-19 using two 50-U. S. gal. barrels equipped with Jones-Attwood air diffusers and quite recently a working-scale mechanical-agitation unit of about 240,000 U. S. gal. daily capacity was put in use. A pamphlet report dealing briefly with these tests and reviewing experiences in a few English cities, with incidental reference to American results, has been made by F. W. Harris, city analyst and corporation chemist of Glasgow, and has been published by the Conveners and Members of the Committee on Sewage Disposal of the Corporation of Glasgow.

SPACE RESTRICTIONS due to the war having come to an end, Sir Alexander Houston's annual reports on the Chemical and Bacteriological Examinations of the London Waters are resuming their old-time fulness. The report for the year ended March 31, 1923, extends to about 100 pp., including many tables and a few plates. The interesting and satisfactory results with chlorination as a substitute for storage to effect bacterial reduction were continued during the year and resulted in saving some $80,000. Begun originally to save the coal used for pumping to the reservoirs for improvement of the water by storage, chlorination seems now to have established itself at London. By whatever means attained, Sir Alexander is a firm believer in making the water supply as hygienically safe as possible before it is applied to the slow sand filters. Small-scale studies of mechanical filtration but without coagulation were continued in 1922-23 and are summarized in the report. Indications are that mechanical filtration will finally be introduced for London water, but apparently for prefiltration and at least in the beginning to cope with organisms that, from time to time, block some of the slow sand filters. The report details some interesting but thus far unsuccessful studies designed to throw light on the relation of fish and sea-gull dejecta to B. Coli in the large uncovered London reservoirs. The use of bacteriophages to distinguish B. Coli from human and various animal sources is another one of Sir Alexander's many adventures in the field of water bacteriology. This study has not yet brought success. (London: P. S. King & Son, Ltd.; 15 shillings.)

New Books and Revised Editions

BRIEF DRAWING—By Ralph Curtis Ringwalt, LL.B., Member of the New York Bar. New York and London: Longmans Green & Co. Cloth; 5x8 in.; pp. 214. $1.50.

DER WASSERBAU—III Teil des Handbuchs der Ingenieurwissenschaften. Erster Band: *Die Gewasserkunde*—Von P. Gerhardt, R. Jasmund und H. Engels. Fünfte vermehrte Auflage. Leipzig: Wilhelm Engelmann. Cloth; 7x10 in.; pp. 806; 64 illustrations in the text, mostly line cuts.

ENGINEERING NON-FERROUS METALS AND ALLOYS—By Leslie Aitchison, Consulting Metallurgist to the Air Ministry, The Association of Drop Forgers and Stampers, etc., and William R. Barclay. With an introduction by Engr. Vice-Admiral Sir George G. Goodwin, K.C.B. (Late Engineer in Chief Admiralty), Past Pres., Inst. of Metals. [Oxfor Technical Publications.] London: Henry Frowde and Hodder & Stoughton. New York: Oxford University Press, American Branch. Cloth; 6x9 in.; pp. 300; 82 line cuts and halftones. $7.

Part I of this British book takes up general properties, constitution, casting, working, heat treatment, mechanical properties and testing. Part II deals with copper, aluminum and nickel, each with its alloys; miscellaneous non-ferrous alloys; and the choice and specification of non-ferrous alloys.

HANDBUCH DES MATERIALPRUFUNGSWESENS für Maschinen- und Bauingenieure—Von Dipl.-Ing. Otto Wawrziniok, ord. Professor an der Technischen Hochschule, Dresden. Zweite vermehrte und vollständig umgearbeitete Auflage. Berlin: Julius Springer. Cloth; 6x9 in.; pp. 700; 641 line cuts and halftones. $5 in Germany.

THE JOHNS HOPKINS UNIVERSITY LECTURES on Engineering Practice for 1922-23 include: The Relation of Highway Research to Modern Road Construction, by A. T. Goldbeck, chief, Division of Tests and Research, U. S. Bureau of Public Roads, Washington, D. C.; Possibilities for Steam Railroad Electrification, by Norman Wilson Storer, general engineer, Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa.; and Power Development—Past and Future—by George A. Orrok, consulting engineer, New York City. Baltimore: Johns Hopkins Press; paper; 6x9 in.; pp. 90; halftones and line cuts. $1.

MANUAL, AMERICAN RAILWAY ENGINEERING ASSOCIATION: Definitions, Specifications and Principles of Practice for Railway Engineering—Edition of 1921. 6x9 in., pp. 1004. Cloth, $8; half morocco. $10.

The revised Manual brings the information contained in the edition of 1915 up to date. By a very complete set of specifications, definitions and descriptions, and by references to the proceedings of the association, it provides a handbook on the following subjects in the field of railway engineering: Roadway, ballast, ties, rail, track, buildings, wooden bridges and trestles, masonry, signs, fences, crossings, signals, interlocking records and accounts, organization, water service, yards and terminals, iron and steel structures, railway location, wood preservation, electricity, conservation of natural resources and uniform general contract forms.

LES METHODES MODERNES D'ORGANISATION INDUSTRIELLE—Par L. Benoist, Ingénieur Des Arts et Manufactures. Avec Exemples du Calcul des Temps D'Usinage en Construction Mécanique par Hermann. Paris. Gauthier-Villars et Cie. Paper; 6x8 in.; pp. 208; line cuts.

THE OFFICE OF THE CHIEF OF ENGINEERS OF THE ARMY: Its Non-Military History, Activities and Organization—By W. Stull Holt. Service Monographs of the United States Government No. 27, Institute for Government Research. Baltimore, Md.: The Johns Hopkins Press. Cloth; 6x9 in.; pp. 166. $1.

PHYSICS IN INDUSTRY—Lectures Delivered Before the Institute of Physics by Archibald Barr, M. Inst. C. E., Emeritus Professor of Civil Engineering and Mechanics, Glasgow University; Sir James Alfred Ewing, M. Inst. C. E.; and Clifford C. Paterson, M. Inst. C. E.; With a foreword by Sir J. J. Thomson, President Inst. P. Volume I. [Oxford Technical Publications.] London: Henry Frowde and Hodder & Stoughton. New York: Oxford University Press, American Branch. Boards, cloth back; 6x10 in.; pp. 59. 85c.

Prof. Barr deals with "Physics and Engineering Science with Special Reference to Mechanical Engineering" and Sir James Ewing and Mr. Paterson with "The Physicist in Engineering Practice" and "The Physicist in Electrical Engineering" respectively. Common to all the addresses is an appeal for research work, and particularly for research laboratories as an integral part of industrial works.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

The Cranberry Marsh Auger Pump

Sir—The new type of pump for low lift work as described by Eugene F. Deléry in *Engineering News-Record*, Aug. 9, 1923, p. 230, brings to mind extensive tests made by the writer in the spring of 1916, in collaboration with J. A. Schad and H. W. Tabor and under the direction of Prof. C. I. Corp of the University of Wisconsin.

The tests were made with an extremely simple type of screw lift pump designed by O. G. Malde, superintendent of the state Cranberry Marsh Experiment Station near Grand Rapids, Wis. These pumps were designed for lifts of 2 to 8 ft. The screw blade impeller operates in a cased opening built into the bottom of a large pit below the lower level of water (Fig. 3). The impeller is keyed to a shaft and the power is applied by means of a pulley attached to the upper end of the shaft above the upper level of water. As the pump operates, the level of the water in the pit increases until the water flows over a weir in the side of the pit.

FIG. 1—IMPELLER BLADES FOR AUGER PUMP

It is interesting to note that while the tests referred to were made for heads varying from 2 to 6 ft. and the New Orleans tests were made for heads of 3 to 14 ft., the efficiency of this crude 16-in. "Malde" pump is as great as that of the 4-in. rotary flow pump described by Mr. Deléry.

By referring to Fig. 2 it will be noted that the maximum efficiency seems quite constant, about 39 per cent, and that for this condition of maximum efficiency the discharge ranges from 3 to 5 sec.-ft. It would be interesting to have these tests extended to a head of 14 or 15 ft. to verify the indication that the same maximum efficiency would be obtained, and to compare the results with those obtained from the pump patented by Mr. Deléry.

The tests made of the simple "Malde" pump show also a broad variation of speeds necessary for maximum efficiency at varying heads, a steadily increasing delivery for increasing speed at constant lift, a large increase of delivery at very low lifts and a well sustained delivery over the whole range of lifts, requiring, however, a necessarily increased horsepower input for the increased lifts. The "Malde" pump does not show a constant power curve for the range of lifts but for the maximum efficiency of operation requires an increasing power input for increasing heads, maintaining, however, a more or less sustained volume of discharge. The maximum efficiency range for the higher speeds, 540 and 650 r.p.m., is greater than for the lower speeds and it is quite probable that were the "Malde" pump operated at the increased speeds of 1,800 to 3,000 r.p.m. the range of maximum efficiency would also obtain over a greater variation in head.

It is doubtful if the reverse nature of the curves for efficiency and discharge, shown on Mr. Deléry's Fig. 3, would persist over a wide range of tests; it would rather

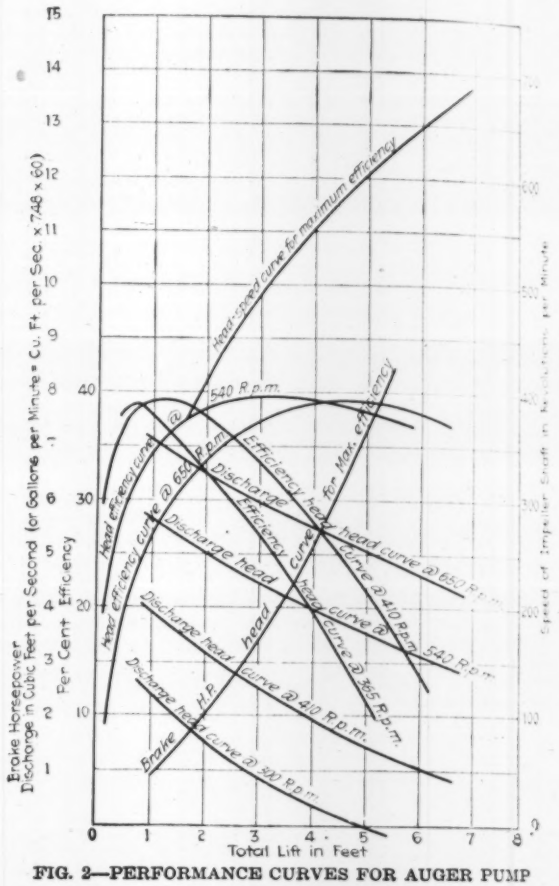

Brake Horsepower
Discharge in Cubic Feet per Second (or Gallons per Minute ÷ Cu. Ft. per Sec. ×7.48 ×60)
Per Cent Efficiency
Speed of Impeller Shaft in Revolutions per Minute
Total Lift in Feet
Head-speed curve for maximum efficiency
1540 R.p.m.
Efficiency curve @ 650 R.p.m.
Efficiency head curve for Max. efficiency
Discharge head curve @ 650 R.p.m.
Discharge Efficiency Curve
Head curve @ 410 R.p.m.
540 R.p.m.
Discharge head curve @ 365 R.p.m.
Discharge head curve @ 410 R.p.m.
H.P. Brake
Discharge head curve @ 300 R.p.m.

FIG. 2—PERFORMANCE CURVES FOR AUGER PUMP

tend to become more regular in outline. It is especially difficult to understand the almost vertical position of the discharge curve between heads of 6 to 7 ft. and the correspondingly almost horizontal position of the same curve between heads of 8 to 14 ft., the power input and efficiency presumably being approximately constant.

Further tests were made of the "Malde" pump after cutting off the lap of the blades, it being stated that it was easier to cast the impeller in this manner than with the blades overlapping. These tests uniformly showed a material decrease in the efficiency of the pump. Final tests

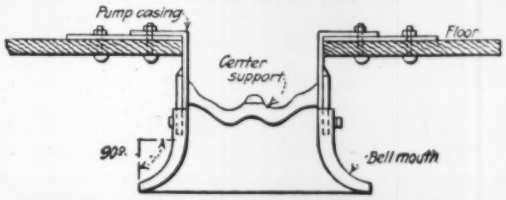


FIG. 3—DETAILS OF THE PUMP CASING
Showing its location in the floor of the pumping well.

were made with a bell mouth inlet to decrease the entrance loss. The resulting increase in efficiency due to this refinement was about 3 per cent.

The increased efficiency which might be expected in a pump with the refinements of the one described by Mr. Deléry over one of the crude type mentioned above is probably overcome by the friction losses within the chambers of the pump itself. Friction losses in the operation of the Cranberry Marsh pump are probably a minimum due to the comparatively large section of the pump pit as compared with the impeller orifice, and the relatively slow velocity of the water with regard to the pump pit walls

Pittsburgh, Pa., Aug. 20, 1923.

M. C. STEUBER, Civil Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Chemists Discuss Sewage and Water Supply

Activated Sludge and Filtration Main Topics at Section Meeting of American Chemical Society

Special Correspondence

Local interest as well as an unusual attractive program was responsible for two popular and enthusiastic sessions of the Division of Water, Sewage and Sanitation, at the 66th meeting of the American Chemical Society, Milwaukee, Wis., Sept. 10-14. John Arthur Wilson's paper on the "Scientific Development of the Activated Sludge Process at Milwaukee" was the center of a discussion that involved many of the sanitary chemists and engineers who have followed this project with intense interest. This formed a part of a symposium that added considerable to the general knowledge of this method of sewage disposal.

Activated Sludge Symposium — Dr. F. W. Mohlman, chief chemist of the Sanitary District of Chicago, discussed the filtration of activated sludge. Operation on a working scale of four types of filters (Simplex plate and frame, Worthington platen, Oliver and American continuous) at the Des Plaines and Calumet plants has shown that treatment of activated sludge with filter alum before filtration flocculates and coagulates the solids and greatly improves filtration. Alum has proved to be superior to sulphuric acid from a practical standpoint. The cost is about the same in each case and the very small addition of alum to the sludge is of negligible significance. Experience at the Corn Products plant at Argo, Ill., seemed to confirm the superiority of alum over other coagulants. Other conclusions brought out in this work are that dilution of sludge frequently accelerates filtration and that the moisture content and biological conditions of the sludge are controlling factors in filtration.

Prof. Edward Bartow, head of the chemistry department at the State University of Iowa, described the treatment of waste from a packing house at Mason City, Iowa. In 1921 an activated sludge plant had been constructed there. Originally it contained a sediment and grease tank, an aëration chamber and a Dorr clarifier. It did not accomplish complete treatment, although great improvement was noted. The excess sludge was mixed with tankage and sold as fertilizer. In remodeling the plant there have been added a Dorr clarifier and a grease skimmer for the removal of heavier solids and greases and a new aëration tank which will double the aëration capacity. Putrefaction in the clarifier is prevented by returning the clarified affluent to the aëration tank during periods of low flow.

Problems in Water Filtration — Dr. George N. Prentiss, chemical director of the C. M. & St. P. R.R., reported that a committee of chemists from the local section of the society had investigated the advisability of filtering the Milwaukee city water supply. Their recommendation—by majority opinion—was that the filtration project might well await the solution of the sewage disposal problem since at present the city water apparently offers no menace to the health of the community. Most of the sanitary chemists present seemed to agree with a statement by one of their number that "chlorination without filtration gives us a pretty slender thread on which to hang the health of half a million people."

Dr. W. D. Hatfield of the filtration plant at Highland Park (Detroit) Michigan offered a modified hematoxylin (colorimetric) test to replace the tedious gravimetric method of determining soluble aluminum in filtered waters. Apparently when restricted to a limited range of hydrogen-ion concentration, the method is satisfactory for all practical purposes.

Ulen and Co. Submits Only Bid on Moffat Tunnel

Ulen and Co., New York, was the only contractor who submitted a regular bid for construction of the Moffat Tunnel, Colo., for which the total amount of the Ulen bid was $6,075,000. At the time of going to press the tunnel commission had announced no decision, but word from its New York office was to the effect that the Ulen company had failed to be awarded the contract. Whether the commission will readvertise, or do the work itself is not, then known.

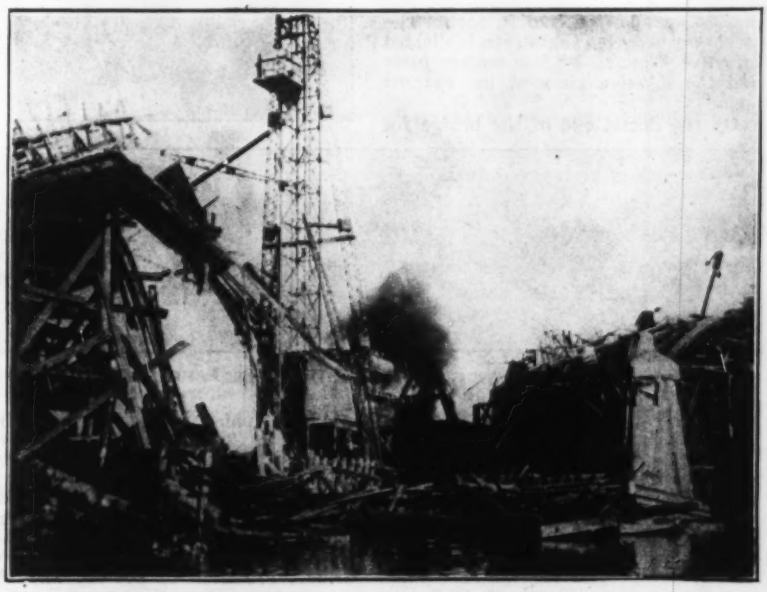
Five Killed in Collapse of Scotia Bridge Span

Falsework Under Skew Arch Gives Way As Concrete is Being Poured—State Engineer Reports

One of the spans on the Schenectady-Scotia reinforced-concrete bridge spanning the Mohawk River and the New York State Barge Canal and known as the Great Western Gateway collapsed the afternoon of Sept. 17, while the last concrete was being poured on the span. Five men are supposed to have been drowned or crushed under the timbers and concrete. These included four workmen, and the engineer for the construction company, Kenneth Davidson. The span which collapsed was the twenty-fourth span, and it went down without warning.

An investigation has been made of the accident by State Engineer Dwight B. LaDu, who reports as follows:

"This department's investigation of the causes leading to the collapse of a span of the Schenectady-Scotia Bridge, discloses the fact that the falsework on the twenty-fourth span of the structure collapsed at 5:15 p.m. Monday, Sept. 17, while concrete was being poured on the two downstream arch ribs of the span. The pouring of the concrete was practically complete at the time the span gave way. This span, which is the first from the Scotia end of the bridge, is on a sharp skew, the falsework being supported by over 96 piles, some additional piles having been placed at the suggestion of the assistant engineer in charge of construction. These piles support the timber bents which, in turn, support eight trusses, two under each rib. The piles supporting this falsework were driven to at



COLLAPSED SPAN OF SCHENECTADY-SCOTIA BRIDGE

least a 15-ton penetration which gave ample bearing power to support the load of the superimposed falsework and the concrete in the arches.

"It is the opinion of this department that there was some slight lateral movement in the piling which resulted in an accentuated movement of the blocking and wedges under the trusses. This movement resulted in a general turning movement of the trusses due to a considerable extent to the sharp skew on which they had been erected. This brought about a general collapse of the falsework and concrete with the resulting loss of life.

"This department, while supervising the construction of this bridge, has no responsibility for the stability of the falsework during the erection of the arch ribs and, under the contract, has no authority to determine the type of falsework to be used. It should be said, however, that the department had already directed the contractor at various times to strengthen the falsework under the spans. No settlement of the abutment or pier has been detected and the state will suffer no monetary loss due to the collapse of the span."

Plans Drawn Before War

Plans for the bridge were first drawn before the World War, but construction upon it was not started until three years ago. Twelve spans had been completed at the time of the accident. The structure has a total length of 4,436 ft. comprising 23 spans of lengths varying from 106 ft. to 120 ft., and one span across the Barge Canal channel of 212 ft. Plans called for width of roadway of 40 ft. between curbs with double tracks for electric cars in the center, and 6 ft. sidewalks. Four arch spans, each 106 ft. long, cross the river channel to the triangular pier on Van Slyck Island, where the bridge turns at an angle of 54 deg. The crossing of Van Slyck Island is in three arch spans 110 ft. each, one arch span 117 ft., all square-ended, and four arch spans 120 ft., each on a skew of 18 deg. Then comes the 212-ft. span across the barge canal which is on a skew, then six 120-ft. skew spans and an anchor pier on the far side of Hog Island, and five more skew spans of 120 ft. each. The structure between abutments is divided into five sections by two anchor piers and the massive piers of the channel span.

On the Scotia end of the bridge for a distance of 940 ft. the approach consists of an earth embankment.

The new structure is to replace an old steel toll-bridge which crosses the river about 1,200 ft. to the east. It will be paid for jointly by the State of New York, the City of Schenectady, the County of Schenectady and the Village of Scotia. The contract plans were prepared by Frank M. Williams, then state engineer, from a design by B. H. Davis, consulting engineer.

Money Asked for Philadelphia Port Improvement

Request has been made by the Department of Wharves, Docks, and Ferries of the City of Philadelphia to have an item of $3,270,000 provided for its use in the loan bill to be submitted in November to popular vote. This sum is asked to carry on the work of the department during the year 1924, and is divided as follows:

Pier 84 South:		
Completion of construction work	$350,000	
Completion of water supply, electrical work, plumbing, heating and sprinkler system	300,000	$650,000
Pier 82 South:		
Completion of construction work	$2,200,000	
Completion of water supply, electrical work, plumbing, heating and sprinkler system	300,000	2,500,000
For the construction of six (6) mud scows at $20,000 each		120,000
Total		$3,270,000

Pier 84 is at present almost complete, but funds are not available for the remaining work. On Pier 82, the substructure has been finished, and the item for construction work on this pier will provide for the entire superstructure.

The request has been made by report of the Director of the Department to the Mayor, and will be forwarded to City Council later. Public works of all kinds have been brought to a standstill in Philadelphia because the borrowing capacity of City Council has been completely exhausted. It is now intended that a large loan, which may reach a total of $40,000,000 or $50,000,000, will be submitted to the voters in November. This new loan will include funds for completion of the Delaware River Bridge, provision of subway and elevated railway lines, the improvement of the port facilities, construction of sewage disposal plants, etc.

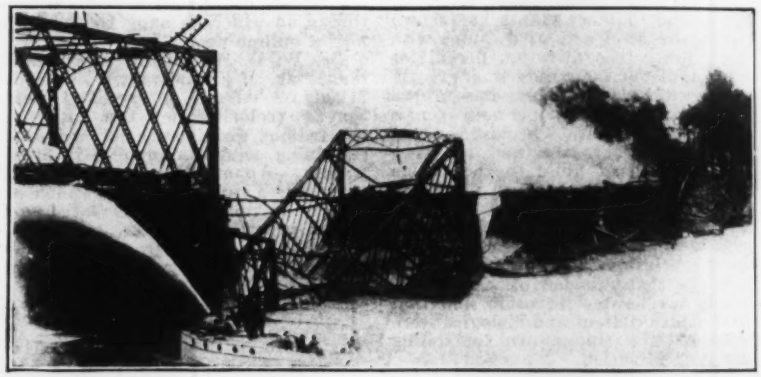
Temporary Relief Sought for Springfield Traffic

Following destruction of the North End bridge at Springfield, Mass., by fire Sept. 8, (*Engineering News-Record*, Sept. 13, p. 451) temporary measures for traffic relief between Springfield and West Springfield are being sought by city and county officials. Several plans have been considered but no definite project yet has been decided upon. Proposals to span the Connecticut River with an army pontoon bridge were discarded as being too expensive. No report has been made yet as to whether piers can be used without considerable reconstruction, so the feasibility of a temporary timber structure upon the old site remains uncertain.

The county commissioners of Hampden County have been trying to discover if they possess authority, through the enabling act of 1872 which authorized construction of the destroyed structure, to build a new bridge. It seems to be prevailing legal opinion that new legislation will be necessary.

Apportionment of cost of removing wreckage, as well as providing temporary traffic relief, has been a subject the county commissioners and city councils of the two towns affected have been perplexed by, though the question of wreckage removal cost has been waived, exigencies demanding that the five twisted steel spans be taken from the river before any possibility of ice and consequent jamming arises.

Partial telephone and electric light service was resumed the day following the fire by the placement of temporary cables in the river bed.



TWO VIEWS OF NORTH END BRIDGE, SPRINGFIELD, DESTROYED BY FIRE, SEPT. 8

Plan Elevator for Vancouver

To provide increased storage accommodation for the rapidly-growing shipments of wheat from the prairie provinces, an additional grain elevator with capacity for 2,000,000 bu. is to be erected at Vancouver, B. C. immediately. Work on the structure is expected to occupy four months, but it is expected to have a portion of it ready in time to handle the 1923 crop.

New Road Gives Entry to Chicago From Indiana

An agreement has been entered into by the Indiana State Highway Commission and Lake County to construct a paved highway from a point near Dyer, Ind., to 106th St., Chicago. The pavement from 106th St. for a distance of 1.56 miles will be approximately 69 ft. wide. The entire project is about 16 miles long. A large portion of it is already paved. The highway commission is to pay one-third the cost and Lake County two-thirds. Under terms of the co-operative agreement the highway commission will construct the road from the intersection of the Evansville-Chicago road with the Lincoln Highway to the north line of St. John township, Lake County. The county will build the road from this point to Roby, where State Roads Nos. 2, 8, 43 and 48 converge at the intersection of Calumet and Indianapolis avenues.

Public Ownership League Holds Convention

Protest was raised against Henry Ford's proposal to secure the Muscle Shoals property at the annual convention of the Public Ownership League of America held at Toronto Sept. 11-14. The convention passed resolutions protesting against any move on the part of the U. S. Government to accept the Ford proposal, on the ground that the power should remain the property of the people.

Outstanding among the various addresses was that delivered by Sir Adam Beck, chairman of the Ontario Hydro-Electric Commission, who gave a comprehensive account of the rise and progress of the provincial hydro-electrical system. He urged the immediate development of new services of power supply.

Earl D. Thompson, secretary of the League, discussed "Super-Power the Supreme Issue." Hon. George W. Joseph of Portland, Ore., dealt with "Public Ownership Possibilities in Oregon" and urged the saving of the water powers for the enrichment of the state. "Public Ownership of Telephones in Manitoba" was the subject of a paper by Mrs. J. E. Lowry.

The public ownership of railroads was advocated by Amos Pinchot, of New York, who considered it the most important problem before the public and asserted that the industrial concerns and railroads were spending probably millions yearly to convince the public that it cannot run its own railroads.

A resolution was adopted calling for a nationwide superpower system publicly owned and operated throughout the United States, steps to be taken at once to co-operate with members of Congress and others interested with a view to drafting a suitable measure. Charles K. Mohler, consulting engineer, Chicago, contributed a paper on "Essential Features of a Model Super-Power Law." George Wright, of the Toronto Transportation Commission, gave a history of the street railway system, claiming that it was a true type of successful public ownership. A. Emil Davies of London, England, chairman of the Nationalization Society, gave details of the progress of public ownership in Britain.

Traffic Is Chamber Topic

A general survey of the waterways of the country as the basis for preparing a comprehensive plan for their development by the government, the establishment of joint rail and waterway routes and dates, and the regulation of common carriers on waterways was discussed at the meeting of the committee on the development of waterways and the co-ordination of rail and waterway service of the United States Chamber of Commerce at its meeting on Sept. 11. The committee hopes that it will be able to outline methods of increasing the traffic on the Great Lakes and on the government barge line on the Mississippi as a means of relieving the general transportation situation.

Chicago Station Permit Issued

A building permit for the construction of the $6,000,000 Union Station building in Chicago has been granted to the Terminal Building Co. This is Chicago's second largest building project and will be the largest one-level terminal in the world. It will be surpassed in size only by the Pennsylvania and Grand Central terminals in New York City, which are both two-level terminals.

Seattle Engineers' Home Moved

IN ORDER to make way for the Community Hotel, contract for the construction of which was recently let, the building occupied by the Seattle Engineers Club was blocked up 12 ft. on cribbing and moved more than a block from its old location. The building is only six years old and has a replacement value estimated at more than $60,000. It was recently purchased by the Plymouth Church and was moved to their property. The Engineers Club will lease from the church trustees for a five-year period. As it cost but $20,000 to move the club building, it is considered a good investment, particularly because in its new site a basement story will be built on to make room for rentable store space. During the time the building was being moved regular meetings of the Engineers Club, lunches and all normal activities were uninterrupted. Heating was accomplished by electric connections and by special heaters. Water supply and sanitation were also maintained throughout the five weeks the building was being moved.

Plans Complete for Session of Construction Council

First Annual Meeting of Body to Be Held at Engineering Societies Building Sept. 21

The first annual meeting of the American Construction Council will be held at the Engineering Societies' Building tomorrow, Sept. 21, at 2 p.m., which session is to be followed by a dinner meeting at the Hotel Commodore at six o'clock and by an evening session in that hotel. Tomorrow morning there will be a meeting of the board of governors and the executive committee at the home of the president of the Council, Franklin D. Roosevelt. On the morning of Sept. 22 there will be meetings of the committees of the Council by special appointment.

Afternoon Meeting

The afternoon session will be opened by Mr. Roosevelt, who will be followed by H. A. Wheeler, vice-president of the Union Trust Co. of Chicago. Important topics to be discussed after Mr. Wheeler's address include: "Local Autonomy and National Organization in the Construction Industry," by Harry T. Stevens, president, New Jersey Building Congress, and Richard A. Wolff, secretary, New York Building Congress; "Apprenticeship, Vocational Guidance and Craftsmanship in the Construction Industry," Fred F. Moran, New York Building Congress; "Reduction of Unemployment in the Construction Industry," A. P. Greensfelder, Fruin-Colnon Co., St. Louis; "The American Construction Council's Program on Research," which is a report of the committee of the American Construction Council on public information and research, given by Dwight L. Hoopingarner, chairman. After the first three named addresses, committees of the Council having to do with these three subjects of discussion will report and discussion upon the report will be invited.

Evening Sessions

The dinner session will be opened by an address by the executive vice-president of the Council, D. Knick backer Boyd. The possibilities of an international exhibition of the construction industry during the sesqui-centennial exhibition in Philadelphia will be explained by the chairman of the executive committee of the Exhibition Association, Ernest T. Trigg. This will be followed by an address by E. T. Brunner, editor of *American Contractor*, on "A Look Into the Future of the American Construction Council."

At the evening session, which is scheduled to begin at eight o'clock at the Hotel Commodore, there will be a discussion by representatives of the twelve constituent groups of the Council on "What the American Construction Council Can Do to Help Our Branch of the Construction Industry." These will be followed by officers' reports, reports of the committees on resolutions, meetings of the twelve constituent groups for election of the board of governors, and the annual meeting of the board of governors.

Should the evening meeting not be finished by 10 o'clock it will be concluded Saturday morning.

Random Lines

BOY WANTED ABOUT 71 YEARS of age for blueprint work.—*Buffalo News.*

Well! There's one field left open when we get too old for real engineering.

* * *

More "Engineers"

An advertisement in the Bridgeport *Post*—

WANTED—Two men, reliable, to qualify for positions as business engineer; salary $3,000 and up; willingness during spare time to acquire understanding of this work more essential than previous experience.

There should be admitted to the profession, too, Mr. Ben Gardner, **dwelling engineer** of Sacramento, Cal., who advertises that he has keys for anything and that he repairs doors, windows, locks, porches, roofs, stairs, chimneys and furnaces; the **electric sign engineers** of the Thos. Cusack Co., whom a Buffalo paper lauds and an unnamed **amusement engineer**, who figures prominently in the advertising columns of the Philadelphia *Record*. *Good Housekeeping*, not to be outdone, has now a department of **Household Engineering.**

And out in Seattle, Floyd Foster Barnes, **human engineer**, is lecturing on such typically engineering subjects as "Psycho-Analysis and Love" and "Thoughts Are Things."

As a special feature of the Golden Jubilee Celebration at Lakeside, Ohio, there is to be a trilogy of pageants and the management is pleased to announce that "Mrs. Ruth Mougey Worrell, **pageant engineer** of wide and highly successful experience, has been secured as author and director of this feature of our celebration."

* * *

Blow Warm, Thou Air Blowers

Dimitrie Joanowici, Rumanian inventor who claims to be able to keep the harbors of Montreal and Quebec and Cabot Straits open for the winter navigation, is asking the sum of $2,000,000 as recompense for his secrets. He stated recently that he had placed his proposals before Hon. Ernest Lapointe, Minister of Marine and Fisheries, and that Mr. Lapointe had given him a good hearing. Mr. Joanowici stated Mr. Lapointe had informed him that the matter would be considered by the departmental engineers before any conclusion was reached. Mr. Joanowici's plan for keeping Cabot Straits open involves the use of a number of powerful electrically-driven air blowers which would be placed on the coasts of Newfoundland and Cape Breton. They would be used to divert the course of the ice so as to keep the straits open.

The above note was sent in as a serious communication by our Montreal correspondent. On reading it over we concluded it belongs in this column.

Hetch Hetchy Power Distribution Question in Limelight

M. M. O'Shaughnessy, city engineer of San Francisco, has recommended to the board of supervisors that the city immediately begin suit to condemn the local distribution system of private power companies for use in distributing Hetch Hetchy power. This would provide definite information on which the voters could choose the alternative of wholesaling power or acquiring a distribution system.

Attention concentrates on the subject at this time because the Moccasin Creek plant, the first Hetch Hetchy unit, is nearing completion with a capacity of forty-five per cent of the city's requirements.

Without reference to Mr. O'Shaughnessy's report, the board of supervisors passed by a vote of fifteen to two a resolution putting that body on record as "unequivocally opposed to the policy of entering into any contract, lease or agreement of any kind for the distribution of Hetch Hetchy power to or through any private corporation," and declaring that absolute municipal ownership and direct distribution to consumers of Hetch Hetchy power is the city's basic policy. The resolution also urged the appointment by the mayor of five citizens to negotiate with the private companies for the purchase of a distribution system and further instructed the city engineer to prepare plans and specifications for a distribution system capable of supplying all electric light and power requirements within the city. The power companies have already stated that their systems are not for sale.

Approval by popular vote is necessary before funds would be available for purchase or duplication of distributing systems. Mr. O'Shaughnessy's recommendation is for wholesaling power until final decision is made, thus avoiding the loss of $2,000,000 annually that would result from failure to utilize Moccasin Creek power.

Applications for Power Sites in Utah Conflict

The so-called Split Mountain site near Vernal, Utah, on the Green River, has come into prominence through conflicting applications to develop power at that point. One application has been filed with the state engineer of Utah by a Mr. Ratliff, Vernal citizen, for a combined power and irrigation project, and the other application has been filed with the Federal Power Commission by the Utah Power & Light Co. for a preliminary permit for a power development. Mr. Ratliff has also requested the Department of the Interior to grant him an irrigation right for 16,000 acres of land at or near the site, and as he is reported to be backed by Col. A. E. Humphreys, of Denver, Col., it is expected that he will be in a position to start developments at an early date, whereas the Utah Power & Light Co. has no immediate prospect of a market in the region of the power site and would consequently have to develop a market before it could undertake the development. The Federal Power Commission will not be called upon to make a decision in this case until the Ratliff interests make formal application to it for a preliminary permit.

Wallace Finds Removal of Davis Is "Backward Step"

In forcing out A. P. Davis as director of the Reclamation Service, Secretary Work of the Department of the Interior took a backward step and for reasons contrary to the policy of many industrial enterprises, L. W. Wallace, executive secretary of the Federated American Engineering Societies, declares in a statement which points out successes attained by engineers in business.

"Requesting the resignation of Mr. Davis," says Mr. Wallace, "Secretary Work gave as his reason that he believed the Reclamation Service should be administered by a business man and not by an engineer.

"The only inference one can draw from this is that he considers an engineer not competent to direct the business phases of a large enterprise that is essentially engineering in character, as is the Reclamation Service. The clear implication is that Secretary Work, a professional man, being a doctor, is of the opinion that members of the professional group of engineering are not successful administrators of business and particularly those lines of business that are essentially engineering.

"Evidently the Secretary does not know that many technical directors of large works within and without the Government Service have ably directed such projects both from a business and a technical point of view. It would appear that the Secretary does not know that one of the marked tendencies in recent years has been the placing of technically-trained engineers, chemists and scientific men in charge of large industrial and commercial enterprises.

"Obviously he does not know that many engineers, who, after they had secured their technical education and experience and while firmly establishing themselves as engineers, have coincidently come into prominence because of their business ability. One of the Secretary's colleagues on the Cabinet, the Secretary of Commerce, Herbert Hoover, is an illustration."

Advertising Signs to Be Removed From Connecticut Highways

On the ground that they are a menace to the safety of the traveling public, the Connecticut State Highway Department has ordered removal of all signs abutting the highways in an illegal way. Co-operating with the state police department and the motor vehicle department, steps have been taken to remove immediately many new advertising signs which have come to the attention of the state officials.

Orders have been issued to all district supervisors of the highway department to notify foremen in their jurisdictions to see that all such signs are taken down at once. At the same time, the department has notified its divisional officers that the attention of the state police will be called to all such violations.

Statutes prohibit the use of any sign, large or small, within the highway limits. In this class is included the great variety of posters which are frequently seen tacked to telephone poles and trees. The state police department estimates that no less than 5,000 signs of all descriptions were removed during the last year for various causes.

Council-Manager Plan Adopted by Portland, Maine

By a vote of 9,924 to 7,691 the electors of Portland, Me., approved a council-manager charter on Sept. 10. There were 6,931 votes for retaining the present charter and 640 for a revised charter prepared by a committee headed by C. S. Chaplin, mayor of Portland. Some 72 per cent of the registered voters took part in the election. The new charter will go into effect next January.

New Precedent in Rail Valuation Established by the I.C.C.

The Interstate Commerce Commission has finally disposed of the first two contested cases of tentative valuations and has fixed "final single sum values" of $45,000,000 on the San Pedro, Los Angeles & Salt Lake Railroad Co. and $23,245,257 on the Atlanta, Birmingham & Atlantic R.R. These figures are substantially the same as the tentative values announced some time ago and have been fixed at extended hearings in which the protests were completely overruled.

The findings in regard to the Atlanta, Birmingham, & Atlantic are regarded as having established a precedent for further valuation work in that, although the Atlanta line has consistently been losing money, the commission states that the valuation could not be based upon the "junk worth" of the property inasmuch as it is rendering a distinct service to the territory traversed.

As the Union Pacific, the controlling company for the San Pedro, Los Angeles & Salt Lake R.R., values it at $75,000,000, it has announced that it will protest the findings of the Interstate Commerce Commission. The Union Pacific claims that this value of $75,000,000 is the value of the railroad as a going concern, but the Interstate Commerce Commission maintains that it is not limited to such considerations and that the "final single-sum value" which it has ascertained for the property of this carrier is based upon a careful consideration of all the relevant facts that have come to its attention. It is, in the judgment of the commission a value which it is authorized by the Valuation Act to ascertain and report. . . "the fair value of the property which the carrier holds for and uses in the service of transportation and upon which it is entitled to earn a fair return."

Civil Service Examinations

UNITED STATES

For the civil service examinations named below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission.

Junior Engineer—Vacancies in the Bureau of Standards, Washington, D. C.; examinations to be in the subjects of ceramic, chemical, civil, electrical, mechanical and radio engineering, and the engineering of materials; positions at entrance salaries ranging from $1,200 to $1,590 a year plus increase of $20 a month.

Examinations will be held throughout the country on December 5, 1923.

CANADA

For the following civil service examination, apply to the Civil Service Commission, Ottawa, or to the postmaster in any of the large cities of Canada.

Geologist—For the Geological Survey, Department of Mines, Ottawa, Canada, for work in the field, surveys and mapping, explorations, reports for publication, and other related work; initial salary $3,600 per year.

Application must be made before September 29.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga., Nov. 12-16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

The San Francisco Engineers Club at a luncheon August 29 was addressed by Charles G. Hyde, professor of sanitary engineering, University of California, on his observations and experiences while in Europe, from which he had recently returned.

The Western Society of Engineers Oct. 1 will hear William Frances Gibbs, president Gibbs Bros. Co., New York, speak on "Reconditioning the Leviathan." On Oct. 15 transportation of perishable freight will be discussed by C. H. Nelson, manager refrigeration department, Atchison, Topeka & Santa Fe Ry., from the standpoint of railroad requirements and by J. W. Inghram, chief engineer, Railways Ice Co., on the engineering of refrigeration. Several engineers and officials of the Peoples Gas Light & Coke Co., Chicago, who studied European practice of gas manufacture and distribution this summer will present on Oct. 29 a symposium on their findings.

Personal Notes

VIRGIL C. LEE, of Anderson, Ind., has been named engineer for the Fort Wayne district of the Indiana State Highway Department to succeed O. B. Kercher, of Goshen, who resigned several weeks ago. Mr. Lee is a graduate of Purdue University. He will be in charge of state highway system in 13 counties.

A. G. SCHAMBERGER, JR., formerly draftsman with Bethlehem Steel Co., Bethlehem, Pa., has been made estimator and draftsman with the Community Steel Corp., and is located at Buffalo, N. Y.

R. W. MCCORMICK, a professor in Rose Polytechnic Institute at Terre Haute, and the first chairman of the Indiana State Board for Registration of Professional Engineers and Land Surveyors, has resigned from the board.

FRED F. FRIEND, formerly hydraulic engineer for the Electric Bond & Share Co., New York City, has moved to California and is now chief engineer of the Palo Verde Drainage and Levee District.

J. W. BLAIR, Texas City, Tex., is now associated with John Monks & Sons, contractors, New York City, as general foreman on construction of sugar refineries. Mr. Blair was formerly general superintendent on construction of the Galveston Causeway.

R. T. MCKAY, until recently concrete engineer with Mamer Co., Benton Harbor, Mich., has been made concrete engineer on the staff of Brussel & Viterbo, consulting engineers, Chicago, Ill.

WILLIAM D. SMITH, formerly chief draftsman for the Port of Tacoma, Tacoma, Wash., is now designer for Hedrick & Kremers, consulting engineers, Portland, Ore.

H. P. HEVENOR, consulting engineer and in this capacity connected with Dwight P. Robinson & Co., Inc., for the past year, has opened offices at 110 E. 42nd St., New York City. For 18 years Mr. Hevenor has been a specialist in track design and construction, for a short time with the Brooklyn Rapid Transit Co. and for five years in the office of the chief engineer of the New York, New Haven & Hartford R.R. In 1916 he entered private practice under the firm name of Engel & Hevenor, and installed track on the New York Seventh Avenue subway, Third Avenue Ry., and Eighth and Ninth Ave. R.R., also did special track construction for the Trenton & Mercer County Traction Co., Capitol Traction Co., Washington, D. C., Newport News & Hampton Railway Gas & Electric Co., Delaware, Lackawanna R.R., New York, New Haven & Hartford R.R. and the Connecticut Co.

GEORGE JEROME, consulting engineer, has been appointed city engineer of Detroit, Mich., by John W. Reid, who became commissioner of public works Sept. 1. Mr. Jerome at the time of his appointment was engineer for the village of Ferndale and conducted a private practice in engineering in Detroit, where he was formerly assistant city engineer.

T. E. MOSS WHEAT, civil engineer, announces the opening of offices at 306 Murphy Bldg., Detroit, Mich., for the practice of civil and structural engineering, surveys, reports, designs, supervision and appraisals, and includes the announcement of the dissolution of the firm of WRIGHT, NICE & WHEAT, Detroit, Mich. Mr. Wheat is a 1914 civil engineer graduate of the University of Michigan, served in the Bureau of Public Works, Manila, and on the erection of a radio station at

Cauacao, P. I., and in the United States as superintendent for the Division of Military Aeronautics of production of aircraft hangars at various factories and later in charge of reclamation of hangar buildings. After the war Mr. Wheat was connected with Smith, Hinchman & Grylls on St. Clair River surveys, city layout including sewer design, water-works and streets, and other construction work.

C. E. PUTNAM, Tacoma, has been appointed city engineer of Tacoma, Wash., to succeed J. C. Manley, resigned. Mr. Putnam has had 20 years of experience in engineering, and since 1921 has been construction engineer in the Tacoma city service.

R. F. RAGLAND, formerly assistant engineer, Yellowstone National Park, is now resident engineer for the Bureau of Public Roads, U. S. Department of Agriculture, in charge of highway construction at Seward, Alaska.

MCKELVEY CONSTRUCTION CO., St. Louis, Mo., has opened a branch office in the Hammond Bldg., Detroit, Mich., with H. E. Anderson in charge. Mr. Anderson has been associated with the company since its organization two years ago.

E. W. BEATTY, Montreal, president of the Canadian Pacific Ry., accompanied by several of the directors of the railway started on Sept. 7 on a tour of inspection of the lines between Montreal and the Pacific Coast.

OTTO M. RAU, a power engineer for many years connected with the Edison General Electric Co. of New York, has been appointed consulting engineer of the Giant Power Survey Board of the State of Pennsylvania. Mr. Rau has established an office in the Fuller Building, 10 South 18th Street, Philadelphia. During the war, Mr. Rau was consulting engineer in the power section of the Emergency Fleet Corporation.

Obituary

SHEPLEY W. EVANS, civil engineer, for many years a member of the firm of Sparks & Evans, Philadelphia, Pa., died Sept. 3 at his home in Merion, Pa. Mr. Evans was a graduate of Dartmouth College in the year 1871.

MANUS MCHUGH, contractor, Philadelphia, Pa., died in that city Sept. 9 at the age of 69 years. Mr. McHugh was born in Londonderry, Ireland, but came to this country in infancy. He had for nearly forty years held municipal contracts for Philadelphia and had constructed many bridges in and near the city.

LANGDON GIBSON, who until two years ago was production manager of the General Electric Co. and had been associated with that company for 31 years, died Sept. 5 at Criehaven, Maine, of cerebral hemorrhage. Mr. Gibson was 58 years old. He was one of the members of the Stanton expedition through the Grand Canyon of the Colorado in 1889 and also accompanied Admiral Peary on his second northern expedition.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

More Motor Vehicles Mean Continued Road Program

Steady Market for Equipment Indicated by Registration of 13,002,427 and Revenue of $200,000,000

For manufacturers of road-building equipment and materials figures on the registration of motor vehicles in the United States for the first six months of 1923, showing a total of 13,002,427 passenger automobiles and trucks, as against 12,238,375 for the entire year of 1922, are significant in indicating the need for a continuing program of both road construction and maintenance. The statistics are contained in a report just issued by the U. S. Bureau of Public Roads, which leaves the Good Roads Board of the American Automobile Association to the conclusion that neither the United States nor any of the individual states are approaching the saturation point in number of motor vehicles in use.

The increase in number of motor vehicles in the United States has continued at approximately the same rate as preceding years, states the Good Roads Board. In the states leading in numbers of motor vehicles where the road programs are also in advance of the other states, and where the first indications of approach to the point of saturation might be expected, the percentage of increase has kept pace and in some instances has outdistanced the records of the Southern states where the road programs are in course of development.

TRUCKS SHOW GAIN

An interesting deduction gathered from the report is the marked increase in numbers of motor trucks for the six months' period as compared with the entire year of 1922, indicating the rapid growth of the use of the motor vehicle for commercial purposes. The truck registration is 1,371,058, an increase of 92,254 since January 1.

In all but nine states, material increases were shown in number of motor vehicles registered during the six months' period of 1923 over the entire year's registrations of 1922. With six months yet to go the record of 1923 in all states will exceed that of 1922.

The State of Ohio climbed up to second place in total number of motor vehicles registered, changing places with California. New York again leads with a total registration during the six months period of 1,025,718 motor vehicles. Ohio is second with 965,000 and California third with 933,808. Pennsylvania is fourth with 922,062; Illinois fifth with 833,920; Michigan sixth with 624,590 and Texas seventh with 571,981. The total number of motor vehicles registered in all of the states during the six months period was 13,002,427 as against 12,238,375 for the entire year of 1922.

The total revenue from registration was $167,240,937.76 for the first six months as compared to $152,047,823.74. In addition to the revenue from registrations the states collected from the motorists $8,669,174.03 in taxes on gasoline during the six months period of this year, as compared to a total collection of $11,923,442.61 for 1922. As the gasoline tax is collected as the fuel is used, the record for the year 1923 may be expected to double that of 1922. The gasoline tax in some of the states did not go into effect until late in the year.

The final record for 1923 will indicate that motorists will have paid direct taxes in registration fees to the states and gasoline taxes approximately $200,000,000, according to the Good Roads Board of the A.A.A. This will not include the personal property tax or special registration or gasoline taxes imposed by cities, counties and townships.

Road Equipment Exhibitors Must Be Association Members

At a joint meeting in Chicago, Sept. 7, of the board of directors of the Highway Industries Exhibitors' Association and Charles M. Upham, recently appointed manager of next year's Good Roads Show and convention of the American Road Builders' Association, a decision was reached requiring all exhibitors at the next show, to be held at the Coliseum, Chicago, Jan. 14-19, to be members both of the Highway Industries Exhibitors' Association and the American Road Builders' Association. A clause covering this requirement will be inserted in the contracts for space at next year's Good Roads Show. According to the terms of the resolution passed, it also becomes necessary for present members of the exhibitors' association who are not members of the road builders to join the latter organization.

The meeting of directors, representing manufacturers of equipment and materials which will constitute next year's exhibit, was characterized by complete harmony and pledges of cooperation between the exhibitors and the road builders. Mr. Upham announced that the floor plan of the Coliseum has been rearranged to provide better facilities and more space for exhibits. In addition, a larger entrance from the Coliseum Annex into the adjoining Greer building will be provided.

Cast-Iron Pipe Production

Based on returns from 12 establishments, statistics on the production, orders, sales and shipments of cast-iron pipe have been issued for the first time by the Department of Commerce. The figures cover the month of June and are as follows:

Production, 81,208 tons; shipments, 88,318 tons; orders to be shipped from stock, 17,905 tons; orders to be made on orders, 199,271 tons; orders not specified as to sizes, 4,366 tons.

American Lumber Manufacturers to Send Commission to Japan

Fifty thousand dollars was appropriated Sept. 1 by the Douglas Fir Exploitation & Export Co., as a cash contribution for Japanese relief, according to a telegram from Seattle to the National Lumber Manufacturers Association, Washington, by Edgar P. Allen, its director of public relations, who has been in San Francisco, Portland, Tacoma and Seattle for several days in conference with West Coast lumbermen in regard to their co-operation in meeting the Japanese crisis. In addition to the cash contribution the association expects t spend $50,000 more in providing technical, executive and administration assistance in rebuilding the devastated regions. Furthermore, the individual lumbermen and sawmills of the West Coast are making contributions to the Red Cross fund and every precaution will be taken to hold down lumber prices for the Japanese and prevent profiteering. The Douglas Fir Exploitation & Export Company is an export association of more than one hundred lumber manufacturers of the Pacific Coast. It is largely through this company that the individual manufacturers transact their ordinary export business with Japan.

In the matter of practical assistance the export company plans to send a commission of lumber experts and building advisors to Japan at once, with the consent and approval of the United States Government. This commission hopes to overcome the chief immediate difficulty in meeting the Japanese emergency demand for lumber, in that it has not been their custom to accept American grades and sizes but have imported according to their own specifications which necessitate special orders.

It will be one of the purposes of the lumbermen's commission to instruct Japanese builders in the use of commercially standard American products in order that full supplies of materials may be furnished without delay. It is believed that the commission of lumber experts will be able to sail to Japan within the next thirty days and in all probability the work abroad will require at least three months of the commission's time.

Shows Way to Make Better Lime

Experiments conducted at the Bureau of Standards have shown a way to improve the manufacture of hydrated lime so that the grade known as "finishing" hydrate is regularly produced instead of the grade known as "masons'" hydrate which, because of its lesser plasticity, commands a lower price. These tests have shown that plasticity depends not alone upon the colloidal content of the hydrate, but upon the effect on this colloid of the manufacturing process. The colloid, like glue, must not be allowed to dry out during the manufacturing process, and it must also be prevented from flocculating itself when the mixing water is added preparatory to use.

It has been found that the drying out can be prevented by letting the freshly made hydrate cool in an atmosphere of steam, while flocculating can be prevented by adding small amounts of a readily soluble calcium salt. A hydrator designed to apply these principles has just been completed for further experiment.

Foreign-Made Brick Appears in American Market

For the first time during the business career of anyone now manufacturing brick, according to the monthly statement issued Sept. 1 by the Common Brick Manufacturers' Association, Cleveland, some competition is felt from foreign-made brick. This is apparent so far, the association states, only in the New York market, where considerable quantities of brick from Germany and Holland are reported to be coming in. It is stated that these brick can be purchased on board ship at German and Holland ports for $4 a thousand, and that American manufacturers cannot compete with this low production cost even after transportation and handling on this side of the ocean has been absorbed. This competition, the manufacturers believe, is not likely to reach far inland, but would affect Atlantic ports unless the American manufacturers in those locations find some protection. American made brick still is claimed to be preferred by the builders in New York and is in ready demand even at a higher price than the foreign made brick.

Cost Accounting Suggestions for Trade Associations

A pamphlet dealing with the acceptance and installation of uniform methods of cost accounting by the members of a trade association has just been issued by the Fabricated Production Department of the Chamber of Commerce of the United States. The pamphlet it designed to "be of assistance to the officers and members of those trade associations which have undertaken to secure the numerous and important advantages of such uniform methods."

The first part of the text is devoted to the ways and means by which the trade association's service to its members may be made the most effective. It deals with such matters as the organization of an association cost bureau and cost councils, and provisions for keeping the members informed of developments generally. The second part is designed to be of direct and substantial value to the president, the general manager, the auditor and other executive heads of the various member companies. It suggests some of the preliminary steps that may well be taken in order to make sure that the association's uniform cost accounting methods are put into use most effectively.

New Manufacturing Plant Opened by Sullivan Co.

Manufacturing began last month at the new western works in Michigan City, Ind., of the Sullivan Machinery Co., manufacturers of compressors, drills and other mining and quarrying machinery. The new buildings were completed some time ago, and during the past month the machinery and equipment have been moved from the company's old plant at Chicago to the new quarters. The new plant is designed for the manufacture of air compressors, diamond core drills, drill steel sharpening machines and cutter bit sharpeners. The new buildings are one-story, and equipped with all modern appliances for manufacturing and handling the product rapidly and at low cost. The plant is served by the Pere Marquette R.R. With these facilities, which will give an initial manufacturing capacity double that of the old works at Chicago, the company announces that it will be able to meet the increased demands from its field and to serve its customers to much better advantage than heretofore.

The general office force and officials of the company, members of the board of directors, the company's bankers, railway officials and others spent a day at Michigan City inspecting the new plant. Addresses were made by Frederick K. Copeland, president of the company since its consolidation in 1892; the president of the Chamber of Commerce of Michigan City and others.

Business Notes

PAWLING & HARNISCHFEGER CO., Milwaukee, builders of traveling cranes, hoists, lumber handling cranes and excavating machinery, announces the appointment of N. B. Norris as manager of its New Orleans office. The company has also opened a new office in Detroit, with James Van Buskirk in charge.

SOUTHERN PINE ASSOCIATION, New Orleans, announces the closing on Sept. 1 of its regional office at Jacksonville, Fla. This action, Secretary-Manager H. C. Berckes states, is in line with the policy of the association not to maintain any regional offices in Southern pine producing territory. The association, however, through the New Orleans headquarters, will continue to render such special services as may be required both to Georgia-Florida subscribers and to those in all other sections of producing territory, as the needs arise.

H. T. GARVIE, chief engineer and general manager of the British Steel Piling Co., London, will arrive in America Sept. 20 for a three weeks' visit. His address will be McKiernan-Terry Drill Co., 15 Park Row, New York City, for whom his company acts as selling agents for all countries outside North America. The British Steel Piling Co. first introduced steel piling in Great Britain 16 years ago and is interested in the representation in Europe and British Colonies of contractors' plant generally, but principally the small tilting-drum concrete mixers, steam shovels, guy derricks, tar macadam plants and similar equipment.

D. F. HOLTMAN, construction engineer of the National Lumber Manufacturers' Association, returned to Washington Aug. 27 after a summer in the West visiting logging and lumbering operations. He was with a party including W. A. Gately of the Department of Commerce, who was making a survey of waste prevention problems and possibilities for report to Secretary of Commerce Hoover; E. P. Ivory of the Forest Products Laboratory, whose special mission was a study of lumber grading problems; and J. E. Jones, Chief Inspector of the Southern Pine Association. C. J. Hogue of the West Coast Forest Products Bureau, arranged the itinerary and accompanied the party.

STONE & WEBSTER, INC., Boston, has opened an office in the Leader Building, Cleveland, Ohio, in charge of J. R. Hammond, district manager of construction and engineering.

Equipment and Materials

Mechanical Loader Designed for Handling Snow

Changes in its elevating conveyor have recently been made by the Barber-Greene Co., Aurora, Ill., to adapt this type of equipment to the loading of snow into trucks. The crawler-mounted chassis of the standard sand or stone loader is retained, but the new feature is the loading boom which, instead of carrying an endless chain of buckets, is equipped with a continuous wide rubber belt. The design of the receiving end of the conveyor also has been altered to provide for wide scoops to gather in and feed snow to the moving belt. The discharge end of the conveyor is provided with baffle plates to deflect the snow to one side or the other.

The overall length of the snow loader is 28 ft., maximum height 12 ft. 9 in., plowing width, 6 ft. 6 in., and weight 12,200 lb. The rated capacity of the equipment is 5 cu.yd. per minute. The inclined loading boom is carried on a chassis with crawler treads driven by a four-cylinder Buda gasoline engine. The machine has four speeds, three forward for loading of 30, 60, and 120 ft. per minute, and one reverse, of 35 ft. per minute.

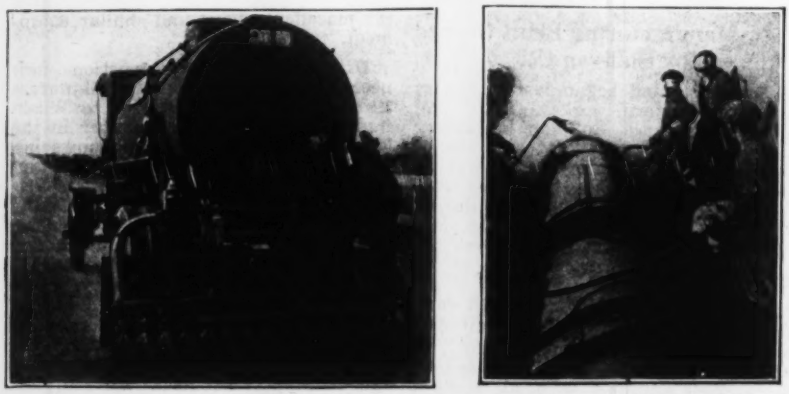
There are two plows or scoops, one on each side of the conveyor belt, which are fitted with hardened steel scrapers and may be adjusted in height with relation to the pavement surface so as to pass over such obstructions as manholes. The conveyor is a four-ply rubber belt, 32 in. wide, with cross-angle flights every 20 in. and is flanked on either side by 12-in. skirtboards to increase its carrying capacity.

On city streets the load can best be utilized in picking up snow which has been pushed by plows toward the gutters. To date more than twenty of these machines have been placed in service by municipalities or street railway companies. The machine can be utilized the year round by exchanging the snow-loading boom for the bucket conveyor boom designed for handling sand, gravel and coal.

Coat Water Pipe With Asphalt from Pressure Distributors

Applying asphalt as a protective coating to water pipe with equipment designed to spread asphaltic oils on roads was the method recently employed by the Los Angeles water department. The work in hand was the coating of 1,500 ft. of 14-in. conduit near the corner of La Brea and Third St., Los Angeles, and was in charge of Thomas Brooks, assistant superintendent of the city water department. Hitherto all such coating had been done by hand with brushes and buckets. Mr. Brooks decided to utilize the large motor truck pressure distributors of the A. F. Gilmore Co., oil producers and refiners of Los Angeles, to apply the asphalt by spraying.

Part of the equipment of these trucks is a metal hose leading from the tanks. It was a simple matter to lengthen the hose and attach. As in the case of oils for road building, the asphalt was heated to the required temperatures at the refinery, loaded into the truck tanks there, hauled to the job and maintained at that heat. The job was completed by three men within seven hours.



PRESSURE DISTRIBUTOR WHICH DELIVERED ASPHALT TO HOSE LINES AND SPRAYS FOR COATING PIPE

Publications from the Construction Industry

Gasoline Locomotives — FATE-ROOT-HEATH CO., Plymouth, Ohio, has published a 31-p. bulletin illustrating the uses of its gasoline locomotives on a variety of heavy construction work. Photographs and explanatory text relating to jobs on which Plymouth locomotives were employed for hauling materials include dams, bridges, dry docks, stadiums, canals, power plants, industrial buildings, filtration plants, subways, aqueducts, and tunnels.

Snow Plows — GOOD ROADS MACHINERY CO., INC., Kennett Square, Pa., features its Champion snow plow in a 31-p. illustrated pamphlet just issued. The plow is designed for attachment to the front end of a motor truck or tractor and consists of a steel scraper blade 10 ft. long and 20 in. wide. The blade may be set at any angle to the line of travel and a lifting device permits the scraper to be raised by the operator. The company manufactures also the Climax snow plow, which is a special adaptation of its road grader for snow removal work. This machine consists of a steel scraper bar attached to a semi-circle and swung under a frame that is carried by a four-wheel truck.

Water Filters—GRAVER CORP., East Chicago, Ind., explains in a 12-p. illustrated bulletin the features of its horizontal pressure type water filters. They consist of a cylindrical steel shell with a manifold and strainer system underneath filtering material of crushed quartz and graded gravel. These filters operate according to the mechanical or rapid sand method and are built in six sizes, all 8 ft. in diameter and ranging from 10 to 24 ft. in length. The process involves the use of a coagulant whose application is regulated automatically by a differential pressure tube. The filters may be operated as single units or, where larger capacities are demanded, in batteries of two or more.

Brass Pipe—BRIDGEPORT BRASS CO., Bridgeport, Conn., presents in an attractively prepared 47-p. illustrated booklet information to assist architects, engineers, builders, plumbers and owners in obtaining the maximum value for a given expenditure for brass pipe as a means of eliminating expense and damage due to corrosion. The text contains a great deal of valuable technical data on corrosion of steel, wrought iron, cast iron and brass pipe. A number of pages are devoted to the manufacturing processes which the company employs in the production of its Plumrite brass pipe including the composition and mixing of material, pouring, piercing, drawing, annealing and testing. Useful suggestions are offered on the selection of sizes of brass pipe for plumbing installations in large buildings. Practical hints are given, also, on cutting threads in brass pipe, cutting pipe, and making joints and bends. The text concludes with a discussion of items of cost in a piping system for hot and cold water service. The company points out that the data in its booklet have taken two years to collect and it is believed that the practices outlined and recommended are representative of the best in use today.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Record Cement Production During August

Production of portland cement in the United States in August totaled 12,967,000 bbl., shipments were 14,971,000 bbl. and stocks at the end of the month were 6,077,000 bbl., according to statistics of the Department of the Interior, prepared by Ernest F. Burchard of the Geological Survey and based mainly on reports of producers. Last month's production exceeded that of the same month in 1922 by 1,303,000 bbl.

For the first eight months of this year production has been 87,907,000 bbl. as against 70,139,000 for the same period last year, or a gain of 17,768,000 bbl.

Shipments for the first eight months of 1923 were 90,909,000 bbl. compared with 76,240,000 bbl. for the same period in 1922.

August production and shipments are greater than in any month thus far recorded and stocks are higher than in August last year.

Public Bond Sales Continue Dull During August

The dullness in the bond market, so noticeable in July of this year as compared with previous years, continued during the month of August. The aggregate of the bond disposals for August, according to the *Commercial and Financial Chronicle*, is only $49,750,564, as against $69,375,996 in August, 1922. Not many issues of one million dollars or over figured in the awards for the month the present year. The state of California put out $4,000,000 4½-per cent highway bonds; Rapides Parish, La., issued $2,000,000 5-per cent road bonds and Crawford County, Pa., issued $1,000,000 4½-per cent road bonds.

The number of places in the United States selling permanent bonds and the number of separate issues made during August, 1923, were 340 and 474, respectively. This contrasts with 387 and 561 for July, 1923, and with 537 and 701 for August, 1922.

Of the 44 representative bond issues included in the accompanying table four were sold at par, three below and the remainder above par. The yields ranged from 4.20 to 5.99 and the rate of interest from 4½ to 6 per cent.

Immigration Statistics on Labor in Construction Industry

Immigration statistics recently made public by the Department of Labor and presented to its members by the Associated General Contractors of America give facts concerning the number of aliens entering the country who may be considered as potential additions to the ranks of construction labor.

The figures show that a total of 522,919 immigrants were admitted to the United States during the last fiscal year as compared with 71,450 aliens who emigrated from the United States during the same period. Of the immigrants 307,522 were men.

A list of occupations of the immigrants includes the following: Carpenters and joiners, 12,305; iron and steel workers, 4,076; painters and glaziers, 2,550; plumbers, 1,197; metal workers, 764; masons, 3,276; stone cutters, 521; tinners, 512; mechanics, 4,644; blacksmiths, 2,296; and laborers, 83,552.

More carpenters and joiners came

REPRESENTATIVE BOND SALES DURING AUGUST & SEPTEMBER

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Delaware	Highway	600,000	4½	102.82	4.35	Jan. 1, 1923	Jan. 1, 1963	Barr Bros. & Co., New York
County								
Allen, Indiana	Roads	128,000	5	100.70	4.86	Aug. 1, 1923	1924-1933	First National Bank, Fort Wayne
Carteret, N. C.	Road and bridge	50,000	5½	102.38	5.34	July 1, 1923	1933-1962	Stacy & Braun, Toledo
Chowan, N. C.	Road and bridge	150,000	5½	100.02	5.24	July 1, 1923	1926-1953	Kauffman-Smith-Einert & Co., Inc., St. Louis
Fillmore, Minn.	Road	100,000	4½	101.50	4.61	Aug. 1, 1923	1933-1942	Northwestern Trust Co., St. Paul
Gastonia Graded School District, N. C.	School building	100,000	5½	101.71	4.93	Aug. 1, 1923	1925-1949	Lewis S. Rosenstiel Co., Cincinnati
York, Pa.	Road	1,000,000	4½	100.78	4.20	Aug. 5, 1923	1934-1953	Brown Bros. & Co., Harris, Small & Co., Biddle & Henry, Philadelphia
Alpena Union School Dist., Mich.	School	200,000	5	101.67	4.85	Aug. 15, 1923	1928-1952	Security Trust Co., and Whittlesey, McClean & Co., Detroit
Ann Arbor School Dist., Mich.	Public schools	100,000	4½	97.59	4.69	Oct. 1, 1922	1941-1943	Harris, Small & Co., Detroit
Blue Earth, Minn.	Roads	100,000	4½	101.29	4.63	Aug. 1, 1923	1933-1942	Kalman, Wood & Co., Merchants Trust & Savings Bank & Syndicate, St. Paul
Crawford, Pa.	Roads	1,000,000	4½	100.54	4.20	Aug. 1, 1923	1928-1948	Titusville Trust Co., Titusville
Jackson, Minn.	Roads	150,000	4½	100.02	4.74	Aug. 1, 1923	1933-1942	Paine, Webber & Co., and Lane, Pipper & Joffray, Inc., Minneapolis
Lake County Special Tax School District, Fla.	Schools	60,000	5½	101.21	5.41	July 1, 1923	1933-1953	First State Bank of Eustis
Medina School Dist., Ohio	Schools	80,000	5	100.00	5.00	June 1, 1923	1924-1944	V. W. Furber, Akron
Tompkins, N. Y.	Highway improvement	200,000	4½	100.09	4.49	Aug. 1, 1923	1924-1943	Sherwood & Merrifield, New York
De Kalb, Ind.	Drainage	63,664	6	100.03	5.99	June 1, 1923	1924-1933	Fletcher-American Co., Indianapolis
Lake, Ohio	Water supply system	175,000	5	100.01	4.99	April 1, 1923	1925-1942	Second Ward Securities Co., Chicago
Laurens, S. C.	Road and bridge	250,000	5	98.50	5.14	July 2, 1923	1925-1953	Bank of Charleston, Charleston
Whittier School Dist., Calif.	Schools	90,000	4½	100.12	4.74	Aug. 1, 1923	1926-1942	First National Bank of Whittier
Geneva Village School Dist., Ohio	School building	275,000	5½	102.91	5.18	July 1, 1923	1924-1946	Otis & Co., Toledo
Rensselaer, N. Y.	Highway improvement	100,000	4½	100.34	4.22	Sept. 1, 1923	1924-1948	Geo. B. Gibbons, New York
Municipality								
Litchfield, Mass.	Electric light and water	90,000	5½	101.33	5.05	Aug. 1, 1923	1924-1938	Minneapolis Loan & Trust Co., & Minneapolis Trust Co., Minneapolis
Cuyahoga Falls, Ohio	Street improvement	206,993	6	102.14	5.46	Aug. 1, 1923	1924-1932	Richards, Parish & Lamson, Cleveland
Fairport, N. Y.	Water	325,000	4½	100.10	4.49	July 1, 1923	1928-1952	Barr Bros. & Co., New York
Hoboken, N. J.	School	721,000	5	100.04	4.99	Aug. 1, 1923	1925-1963	Geo. B. Gibbons & Co., New York
Leetonia, Ohio	Sewer and sewage disposal	350,000	5½	100.38	5.42	June 1, 1923	1924-1933	Lewis S. Rosenstiel Co., Cincinnati
Michigan City, Ind.	Water works	40,000	5	100.07	4.99	July 1, 1923	1924-1938	Thompson, Kent & Grace, Inc., Chicago
Salisbury, N. C.	School	100,000	5½	100.45	5.22	July 1, 1923	1926-1953	Mississippi Valley Trust Co., St. Louis, and Detroit Trust Co., Detroit
Solvay, N. Y.	Public improvements	200,000	5	101.70	4.82	Aug. 1, 1923	1928-1952	H. L. Allen & Co., New York
Goshen, Ind.	Water, light and power	50,000	5	100.00	5.00	Aug. 9, 1923	1925-1934	Mier State Bank, Ligonier
Greenwood, Miss.	General improvements	168,000	5½	102.08	5.27	Sept. 1, 1923	1924-1943	Wm. R. Compton Co., New Orleans
Leonia School Dist., N. J.	Schools	200,000	4½	100.00	4.50	April 1, 1923	1925-1963	B. J. Van Ingen & Co., New York
New Castle, Pa.	General improvements	125,000	4½	102.23	4.30	Aug. 1, 1923	1938-1943	Harris, Forbes & Co., New York
Northborough, Mass.	Schools	56,600	4½	102.44	4.20	Aug. 1, 1923	1924-1942	Merrill, Oldham & Co., Boston
Ouachita Parish, La.	Courthouse and jail	400,000	5	100.51	4.96	Aug. 1, 1923	1924-1964	Hibernia Securities Co., New Orleans
Rapides Parish, La.	Road and refunding	2,000,000	5	100.00	5.00	Aug. 1, 1923	1924-1942	J. A. Bentley & L. E. French & Co., Alexandria
Redondo Beach, Calif.	Park and improvements	125,000	5	100.31	4.97	Jan. 1, 1923	1924-1963	M. H. Lewis & Co., Los Angeles
Danville, Va.	Water improvement	100,000	5	100.61	4.93	June 1, 1923	1924-1948	Robert Garrett & Sons, Baltimore
Kenosha, Wis.	Schools	200,000	4½	100.40	4.71	Sept. 1, 1923	1929-1943	A. B. Leach & Co., Inc., New York & Syndicate
Evansville, Ind.	Water	270,000	5	102.83	4.68	Sept. 1, 1923	1930-1939	Federal Securities Co., Chicago
Hazleton, Pa.	Public improvement	165,000	4½	103.03	4.28	Sept. 1, 1923	1937-1952	American Bank & Trust Co., Hazleton
Raeford, N. C.	Street improvement	70,000	6	100.62	5.92	April 1, 1923	1925-1944	C. W. McNear & Co., Chicago
Tampa, Fla.	Water works	1,350,000	5	98.67	5.07	July 2, 1923	1924-1972	J. G. White & Co., Inc. & Syndicate, New York
Township								
Vermillion School Township, Ind.	School building	88,000	5	100.31	4.95	Aug. 1, 1923	1924-1937	City Trust Co., Indianapolis

into the country than men following any other single line of skilled work, the next closest total being that of 5,559 tailors.

Lumber Movement Declines

According to reports to the National Lumber Manufacturers Association received from 387 of the larger commercial lumber mills of the country, the national lumber movement declined considerably in the week ending Sept. 8, although substantially larger than for the corresponding week of 1922. The 131 reporting mills of the West Coast Lumbermen's Association and the 129 reporting mills of the Southern Pine Association, however, showed an increase in unfilled orders from 548,820,147 to 563,574,584 ft. For all the mills shipments were 81 and orders 82 per cent of production. For Southern Pine mills these percentages were 83 and 89 and for West Coast mills 87 and 96.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 159 to 171, are the following:

Apartment, Brooklyn, N. Y., Kraslow Building Co., Inc., $1,500,000.

Bank and office, Cleveland, O., Brotherhood of Locomotive Engineers, $5,000,000.

Transmission Line, Timmins, Ont., Hollinger Consolidated Gold Mines, $1,000,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 159 to 171, are the following:

Office, Dallas, Tex., to Watson Co., $5,000,000.

Office, Los Angeles, Calif., to Foundation Co., San Francisco, about $1,500,000.

Road, Florida, 7.121 mi., to C. F. Lytle, Jacksonville, $252,357.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of Sept. 6; the next, on Oct. 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.00
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	—5.30	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.80	3.20	3.45	3.85	3.65	4.10	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	45%	+43%	47%	53–5%	36%	33.2@42.2%	35%	+47.42
Cast-iron pipe, 6 in. and over, ton	63.60	60.00	63.00	60.20	60.50	69.00	62.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	3.00	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.89	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	61.00	40.00	52.25	58.50	+46.75	44.25	38.00	29.00	70.00
Lime, finishing, hydrated, ton	18.20	22.50	—20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	—1.75	1.50	1.50	2.70	2.10	2.80	10.00
Common brick, delivered, 1,000	23.65	11.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.115	.0724	.0816	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1263	.102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.95	.98	—1.04	1.14	.99	1.09	—1.09	.86	1.22
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.50@.62½	+.35@.40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93½c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.56). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.42; 6-in., $119.

Changes Since Last Week

This week's market is characterized by a slightly firmer tendency in lumber. Minneapolis reports an advance of $2 per M. ft. in Douglas fir, while the other eight cities reporting weekly to *Engineering News-Record*, show decided firmness in lumber prices.

Black steel pipe also firmed slightly in Montreal and Dallas while lime quotations dropped somewhat in the latter city.

Raw linseed oil is quoted in Dallas at $1.04 per gal. (5 bbl. lots) as against $1.10, and at $1.09 in San Francisco, compared with $1.16 per gal., one week ago.

Common labor is being paid 35@40c. in Montreal as compared with the former rate of 30c. per hr.

The iron and steel situation, briefly, is as follows: Pig-iron market tending downward since settlement of coal strike. Furnaces piling iron, preparatory to going out of blast until demand improves. Structurals very firm at $2.50 base. Car material demand strong and plate shipments improved. Structural demand also increased, principally for schools, commercial and residential buildings and bridges. Bars stronger; buying active, particularly in cold-finished material. Bulk of present business in sheets and tin plates.